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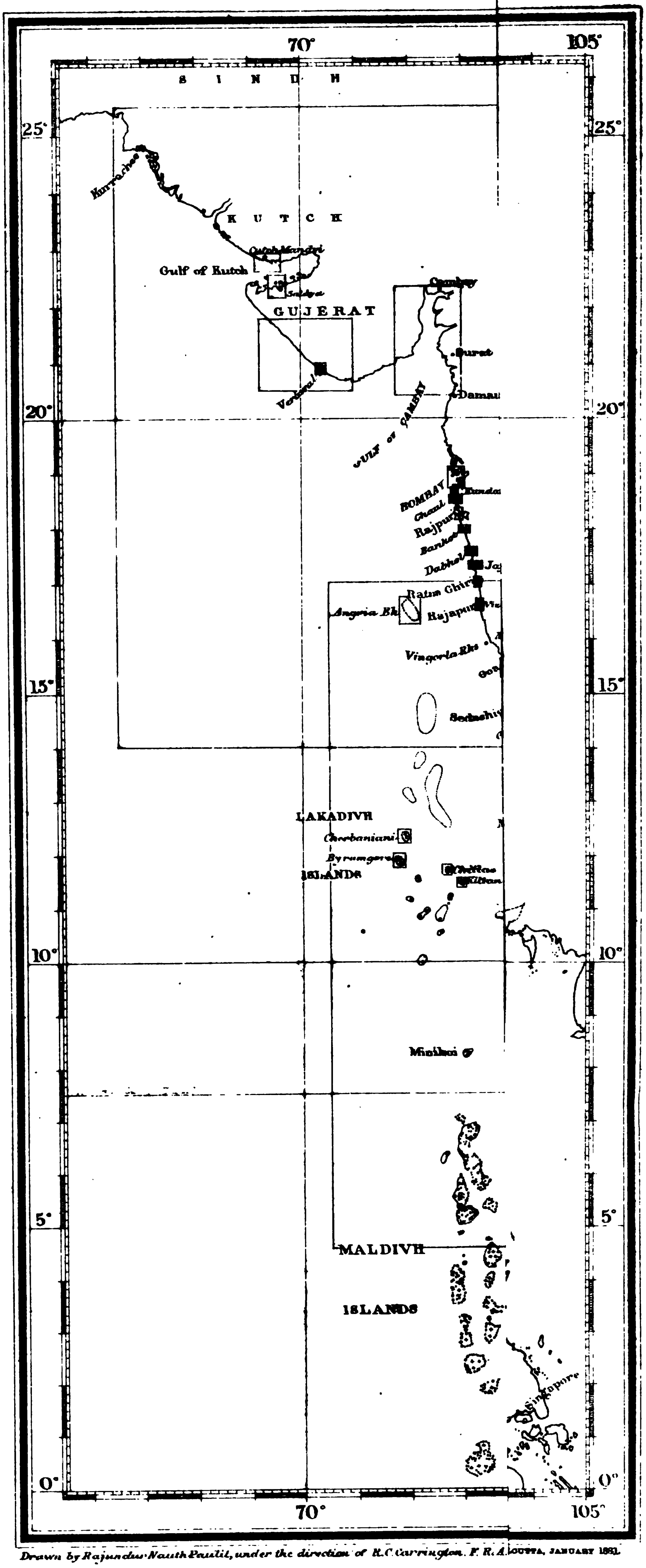

Drawn by Rajunder Nauth Paulit, under the direction of R.C. Carrington. F.R.A. CUTTA, JANUARY 1861.

GENERAL REPORT

ON THE OPERATIONS OF

The Marine Survey of India,

FOR THE YEAR

1879-80.

PREPARED FOR SUBMISSION TO THE GOVERNMENT OF INDIA

BY

COMMANDER A. DUNDAS TAYLOR (LATE I. N.), F.R.G.S.,

SUPERINTENDENT OF MARINE SURVEYS.

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GENERAL REPORT

ON THE OPERATIONS OF

The Marine Survey of India,

FOR THE SEASON

1879-80.

Dated Calcutta, the 1st March 1881.

SECTION I.

GENERAL REPORT.

I have the honour to submit, for the information of the Government of India, my Annual Report of the proceedings of this Department during the surveying year commencing on 1st October 1879 and ending 30th September 1880, giving full details of my inspection of nearly every light-house around the coast of India, of certain cursory examinations of ports executed by myself when on tour, together with the systematic surveys carried out by the Executive Staff of the Department and the out-turn of work in the Drawing Branch and Office.

Tour of inspection of the various light-houses on the coasts of British India.

2. My preliminary General Report on India light-houses, dated 1st June 1879, and printed in last year's Report, was accepted by the Government of India as indicating the necessity of a thorough inspection of all light-houses with the view of ascertaining more particulars regarding the several small lights which have lately been erected or require erection around the seaboard. The Government of India, therefore, gave orders that I should carry out such an inspection, commencing in October 1879 and furnishing a full and detailed report of all the light-houses visited, with such proposals as I deemed it advisable to make; but that attention should be immediately called to any matters requiring, in my opinion, prompt correction. Combining light-house visitation with desultory examinations of the various ports, this inspection tour lasted till the close of April. My General Report (see Appendix A) was duly submitted to the Government of India, and thereupon a resolution, dated 13th August 1880, was issued by the Department of Finance and Commerce thanking me "for the clear exposition of the requirements of each light or port visited," and desiring the local Maritime Governments and the Administration of British Burma to consider my suggestions and "take such measures as they consider necessary for placing the lights in their respective provinces in a satisfactory condition." The Governor General in Council also remarked that "general inspections, such as have been undertaken by Commander Taylor in the two past years, need not in future be made yearly by an officer of the Supreme Government. The whole responsibility for bringing promptly to notice defects in the lights and light-houses rests on the local officers, who should submit annual inspection reports and statements of receipts and expenditure on light-houses, which should be communicated to the Government of India, with the orders of the local Governments or Administration on them, as soon as possible after the close of each official year."

3. I will now state my movements in connection with the light-house inspection. Taking advantage of an opportunity of proceeding to False Point in the Indian Government steamer *Undaunted*, in company with Captain Stiffe, Port Officer of Calcutta, I left Calcutta in that vessel on 7th October 1879. At False Point, having previously engaged the small steamer *Eliza*, I took soundings to correct the existing chart, as Reddie Point had extended considerably northward since the last examination; great changes in the depths of water were known to have occurred, and the spit and fairway buoys had consequently been moved. This re-examination having occupied us two days, we proceeded thence in the *Undaunted* to Pooree, where we inspected the small light and took a few soundings off the port to supplement the coast chart, which previously to my visit showed a complete blank off Pooree. Whilst at Pooree we were informed by Mr. Armstrong, the Collector of the district, that for several years regular monthly measurements had been taken of the breadth and depth of water at the entrance to Chilka Lake, both at high and low tides. These observations are now made fortnightly and forwarded to this Department, where they are recorded for future reference. The information will be valuable in case of another famine in Orissa, as cargo boats, in tow of a steam launch, could enter the lake with some confidence and so distribute grain in the neighbourhood.

4. We left Pooree on the 10th October, and, having such excellent landmarks as Jagarnath temple and the black pagoda, took more soundings along the coast and in the neighbourhood of Davy River, near which the British ship *Philosopher* had been totally wrecked about a fortnight previously. We then entered the Dhamra River and inspected the port of Chándbali, where we found that the channel buoys required to be shifted, but that no local means of weighing or painting them were available. I landed on Shortt's Island, which lies on the south side of Dhamra River entrance, and am quite satisfied that a small light-house could easily be built there. A thorough survey of the Dhamra River entrance, together with the adjacent coast southward and the Palmyra reefs, is much required; but to make a complete examination a steamer properly fitted and equipped is absolutely necessary, and the fine weather of December and January should be selected for conducting the survey of Palmyra's shoals. I returned to Calcutta on the 15th October on the completion of this inspection.

5. On the 7th November I proceeded by rail to Bombay and embarked on board the Indian Government steamer *May Frere* for the purpose of visiting the gulfs of Cutch and Cambay with the intermediate coast ports. On this occasion Captain Baird, R.E., Superintendent of Tidal and Levelling Operations, conveyed to Bhavnagar the self-registering tide-gauge which His Highness the Thakore of Bhavnagar had purchased. On the 12th November we examined the Portuguese port of Diu, and ascertained that it would be easy to erect a tide-gauge at some future time near this place. In paragraph 14 of my General Report upon Indian lights (see Appendix A) I described the kind of light which is needed for Diu Head. In the next two days I inspected Porbunder and Dwarka lights. We then proceeded to Bet harbour and I visited Sainia light; the result of my examination and correspondence with the Baroda Durbar has been that an all-round dioptric light of the fourth order—which is to be obtained from Messrs. Chance Brothers of Birmingham—has been sanctioned for this little islet, whilst the present light apparatus will be transferred to Dwarka. From the 15th to 19th November I inspected all ports and lights between Dwarka and Bhavnagar, as detailed in the General Report (Appendix A), and I recommended the erection of a small revolving light on Diu Head.

6. Between the 20th and 24th November I utilised the *May Frere* in taking some lines of soundings off Bhavnagar and Gogo, and here I may mention that Mr. W. Proctor Sims, C.E., the Executive Engineer of the Durbar, has been making a sectional survey of Bhavnagar creek to be incorporated with my recent work outside the light-house of that place, showing the deep channel into the port. The Bhavnagar Durbar obligingly lent me their Executive Engineer's bunder-boat, which was most useful both for sounding and for the purpose of landing to inspect all the Cambay Gulf lights. I also visited the mouth of the Kim or Kantiajal creek, and, as we had to wait till nearly half

flood before a boat drawing four feet water could enter, it is obvious that the idea of making this creek the Guzerat terminus for a steam ferry is quite unreasonable. In my remarks at page 82 of my Annual Report for 1878-79 I expressed my preference of the village of Karanj, near Bhagwa, but at the mouth of Kantiajal-Kari, as the most likely position for the Guzerat terminus.

7. I inspected the Tapti and Bulsar lights on the 25th and 26th November. So small a steamer as the *May Frere* could not anchor nearer than six miles from the small light at the last-named place, and a large steamer must not come within nine miles, otherwise she would be liable to ground at dead low-water. Between Bulsar and Bombay there is not a light, but one is needed near Dánu point, as mentioned in my report. Having thus finished the inspection of lights in the Gulf of Cambay, we returned to Bombay, arriving there at noon of the 28th November. In the remaining days of that month I inspected the Prongs and Kenery lights and the light-vessels at the mouth of the harbour.

8. On the 2nd December I left Bombay in the *May Frere*, and proceeded to Ratnagiri, where I inspected the light on the highest bastion of the old fortress. In the forenoon of the 4th we anchored off Malwan, where a few hours were spent in examining the lights, as also in obtaining bearings and angles to test the positions of the buoys, and taking soundings throughout the inner harbour; the corrected chart has since been sent to the Hydrographer. On the same day I landed on the outer Vingorla rocks and inspected the light. Afterwards we examined the two lights on the top of Vingorla point. These lights, vertically placed 20 feet apart, are reported by the commanders of coasting steamers as most efficient; their original cost was about half that of the Vingorla rocks apparatus.

9. Having obtained permission from His Excellency the Governor General of Portuguese India to make an inspection of the Goa light-house, I visited the Agoada light-house on the 6th December, and subsequently selected a site for a light-house in Marmagao harbour, having been requested by the Governor of Goa to do so. We then proceeded to Karwar, where I examined the Oyster rocks light, and afterwards to the Coompta light-house, which was also inspected. In the forenoon of the 9th December we arrived off Mangalore and I inspected the light-house. The following day, with the assistance of the boats of the *May Frere*, I examined the bar of Mangalore River and the channel inwards, and also took fresh measurements along the coast sand to determine the changes that have occurred since last south-west monsoon. The corrected chart has been forwarded to the Hydrographer of the Admiralty.

10. The Government of Madras having placed the steamer *Margaret Northcote* at my disposal, I left Mangalore in that vessel and inspected the light-houses at Cannanore, Tellicherry, and Calicut. At the latter place I also took bearings to fix the positions of certain buoys recently relaid by the Port Officer, and prepared a corrected Notice to Mariners on the subject. Having completed this work on the 12th December, we left Calicut and arrived at Cochin on the following day. At that port the light-house was inspected and bearings were taken to determine accurately the positions of the bar buoys; and, as the sand had accumulated westward of the light-house, measurements of it were taken again. I subsequently went with the Port Officer to see the Cruz Milagre Gap (about 2 miles northward of the river mouth), where the sea made a breach about 10 years ago; but this opening has now been effectually closed by the local engineers. It is satisfactory to know that *now*, in consequence of that gap being stopped, there is a greater depth by more than one foot on the bar of Cochin. The great out-rush of tidal and storm water from Cruz Milagre Gap considerably diminished the volume from Cochin entrance, and the result was that after four or five consecutive monsoons, the ridge of sand, which forms Cochin bar, was forced bodily inwards by the hammer of the monsoon swell to the extent of 700 feet; and where the bar buoys formerly stood in 13 feet, I found nearly 20 feet on the occasion of this visit.

11. On the 14th December we left Cochin and proceeded to Aleppey, where I inspected the light as it was burning. In the forenoon of the 15th we anchored off Quilon, where I landed and took bearings and angles to fix the position of the new factory chimney, which is the best leading mark into the anchorage; I also made additions to the soundings and obtained a copy of

those recently taken by the Commercial Agent of the Travancore Government. From this re-examination of Quilon, we have issued a more complete and useful chart of this place, and I am glad to mention that the Travancore Government are likely to put up a light and some buoys at this port.

12. We visited Mutam light on the 16th December, and after taking bearings, I am now able to assign its right position on the coast chart. At sunset we rounded Cape Comorin and soon experienced a fresh N. E. monsoon and chopping sea; and on the following day we anchored off Tuticorin light and inspected it. Early on the 18th we proceeded to Paumben, with the wind against us, and soon after sunset we anchored off Keelakari for the night. Taking a pilot in the early morning, we reached Paumben in the forenoon; here I was gratified to find that the Port Officer, Mr. T. H. Baker, had done good work with the dredger *Albuquerque,* which I last year advised the Madras Government to send there. Mr. Baker has now obtained a depth of 16 feet across the horse-shoe sand-bank, and if more energetic measures were taken by the Public Works Department to cut through the rocky dam, we might soon see vessels with a draught of 14 or 15 feet making seasonable use of the Paumben Pass. After an inspection of the light we returned to Tuticorin and I proceeded by rail to Madras, where I inspected the excellent flashing light. Argand burners, with cocoanut oil, had hitherto been used at Madras, but the Port Officer is now substituting lamps burning mineral oil. The change involves little expense, and the future cost of oil will be one-third the present amount.

13. Embarking in the British India Steam Navigation Company's steamer *Chindwara,* I proceeded to Coconada and inspected the new revolving light at Vakalapudi. I then made arrangements for inspecting the channels towards Hope Island, and had the necessary flags and beacons prepared to fix the exact position of all the buoys.

14. On the 2nd January I left Coconada with the Port Officer of Coconada in the Madras Government steamer *Lady Mary Grenville* for the purpose of inspecting the Hope Island light-house. We had to pass round by Coringa and Yanam to reach the Godavery River, then down that river to Hope Island. In returning we passed out of the new mouth which has been forming during the last two or three years. Finding such an abundant depth of water in this new channel, with 8 or 9 feet at low water in the entrance, and that shoal water extended much further northward of Point Gordaware, I resolved to make an examination of this new Godavery mouth. Between the 6th and 11th January, I was consequently employed with Mr. Gillham, the Port Officer, in making a preliminary survey and in getting the work charted; I also took theodolite angles at Cocanada column and others at Hope Island, and the new Vakalapudi light-house, to fix the correct position of the latter. As the French steamer *Coromandel* was lying aground in the entrance of Coringa River, I took soundings in her vicinity, as the port authorities were dredging a channel through the inner bar in the hope (subsequently abandoned) of getting this large steamer (2,000 tons) up to Coringa for the purpose of docking and repairing her. On the completion of this work we returned to Coconada.

15. On the 12th January, having been informed by a telegram from Calcutta that the I. G. S. *Hugh Rose* had been placed at my disposal for the purpose of visiting the lights on the Burma coast and ordered to meet me at Rangoon, I left Coconada by the British India Steam Navigation Company's steamer *Asia* for Rangoon and arrived there on the 19th January, after touching at several Madras coast ports, where I took the opportunity of inspecting the port-light at Gopalpore. Being anxious to carry out the work of inspection as quickly as possible, I obtained permission from the Chief Commissioner of British Burma to utilise the I. G. S. *Irrawaddy* for visiting the Eastern Grove and China Bakeer light-houses as the *Hugh Rose* had not arrived; having performed this duty, I returned to Rangoon on the 24th January.

16. In the evening of the 27th the *Hugh Rose* arrived, but, as there was no likelihood of her reaching Akyab (against the present northerly breezes) before the 4th February, and I could manage earlier than that date to effect the inspection of the Savage Island and Oyster reef light-houses off Akyab, I proceeded to that port in the British India Steam Navigation Company's steamer *Medina* on the 28th January. On the 30th we touched at Kyouk Phyou, and during the same night arrived at Akyab.

17. On the 1st February I went in the Government steam launch *Brilliant* with the Port Officer of Akyab to inspect the Oyster reef light. In the afternoon of the 2nd we also inspected Savage Island light. From angles observed at these two places I found that the Oyster reef light-house is not properly placed on the chart, so I took the opportunity of being at Akyab to observe other angles at fixed points for the purpose of ascertaining the correct position of the light-house. These operations, as well as attending to official correspondence, occupied me till the 5th February, when the *Hugh Rose* arrived.

18. The condition and requirements of all light-houses were fully reported upon when the inspection tour was finished, but in accordance with the instructions received that attention should immediately be called to any matters requiring prompt attention, I brought to the notice of the Government of India that efficient arrangements for landing on the Alguada reef, and for climbing up the screw-piles structures of China Bakeer and the Oyster reef, have been hitherto neglected. Even in moderate weather the operation of ascending is attended with danger to life and limb, and the task of relieving these light-houses is thus rendered extremely difficult and all the more costly because the relieving vessel has frequently to wait a week or a fortnight till the sea is smooth enough to allow of a small boat going alongside. The present Port Officer of Akyab fully understands the sort of appliance that is needed at the Oyster reef light-house, and a similar arrangement would suit the China Bakeer. It would be a great benefit if the very necessary facilities for climbing up these light-houses were prepared and made ready for use before the next south-west monsoon.

19. On the 8th February I proceeded in the *Hugh Rose* to the Naaf River, which was examined as far up as Moungdoo. I found the entrance channels so tortuous and so long, the distance between the anchorage under St. Martin's Island and the sandy point of the river entrance being about 5 miles, that it became an impossibility to make even the roughest sketch in the few days which could be spared for that purpose. I, however, satisfied myself that vessels of a greater draft than 15 feet were not likely to find an entrance or exit even at high water. This examination occupied me till the evening of 11th, when we returned to Akyab for letters and to fill up with coal.

20. On the 14th February I again left Akyab, and by evening of the 15th we had passed through the north half of Cheduba channel, and I anchored at dusk so as to be able to take a round of angles and true bearings to test some of the dubious positions of islands. This work being done, in the morning of the 16th we moved the vessel southward about a dozen miles, and again anchored with the same object in view. In the afternoon we again weighed and at 3 P.M. anchored off Sandoway. As the result of these operations, I found that the Osprey and Gunga Sagor rocks required to be moved each about 5 miles eastward on the chart. Between the 16th and 19th I made a rapid sketch survey of Sandoway Roads and river mouth, which has been incorporated in the Admiralty chart and is a valuable addition to our knowledge of that almost unexplored coast. Sandoway peak on the chart was found to be 4¾ miles out of its real position.

21. We reached Diamond Island on the 20th February, and on the following day I inspected the Alguada reef light-house and discussed with the European light-keepers the practicability of making an improved landing place on the most sheltered side of the reef. The proposal was afterwards submitted for consideration of Government in my report on light-houses (see Appendix A). On the 22nd February the *Hugh Rose* took up two positions inside the Krishna shoal, whence the light-vessel *Colombo* and the two recently-erected beacons on the shore were visible. I was thus enabled by angles and bearings to connect the floating light with the Baragua shore and Krishna shoal. Time failed me, however, to make any search for the old screw-pile structure; but from the few lines of soundings we took in the *Hugh Rose*, I believe that the old light-house must have been placed too near the inner edge of the Krishna shoal, which has evidently

been a little cut away on that landward side, as we found four fathoms (reduced) where formerly there was marked three on the chart.

22. On the 24th February I inspected Double Island light-house, where (as at Alguada reef, as well as China Bakeer and Oyster reef light-houses) efficient arrangements for landing men and stores are lacking. A very little expenditure would restore the stone wharf at Double Island, which was formed during the construction of the light-house about 15 years ago, but now appears to require more attention than is allotted to it. The old iron crane is too heavy for the mere work of landing provisions and too dilapidated for repair. If this light-house were put under the Port Officer of Moulmein, he would rig a simpler contrivance at very little expense.

23. On the 25th February the *Hugh Rose* reached Moulmein, where we remained for the purpose of coaling till the early morning of 28th, when we weighed and steamed out. But the pilot insisted on anchoring above Amherst because there was not water enough for even a little vessel like the *Hugh Rose* (drawing only 8 feet) to go out at low water. Indeed, it was evident that very marked changes have occurred in the lower passages of the Salween River since the survey made by the officers of this Department in the *Clyde* in 1877. There is, however, a River Surveyor at Moulmein who shifts the channel buoys as occasion requires, and this meets the wants of the pilots.

24. On the 29th February we left Amherst and anchored at Table Island off the Cocos on 1st March, when I visited the light-house. There are two landing places here, one for the north-east and the other for the south-west monsoon. Both might be much improved at little cost; but, under existing circumstances, the landing was difficult although that period was the fine season. It will be remembered that in 1878 two or three deaths occurred by drowning on the occasion of landing a party in bad weather at Table Island. From Table Island (of which I was able to make an improved sketch in correction of that delineated on the Admiralty chart which was very erroneous) the *Hugh Rose* carried me to Port Blair, where she was discharged. I left Port Blair in the British India Steam Navigation Company's steamer *Satara*, and arrived at Calcutta on the 9th March.

25. Again leaving Calcutta on the 23rd March I embarked on board the British India Steam Navigation Company's steamer *Chinsurah* for False Point. The vessel having grounded to the eastward of Hookytolla village, I was enabled to make some useful observations as to tides and currents. Between the 20th and 31st March I obtained a steam launch and proceeded up the Bakood and Jamboo creeks, making such notes as I required about those streams, together with the set of the tides throughout the harbour, which were incorporated in my fifth report upon False Point, dated 27th May 1880 (see Appendix D). I also inspected the new light apparatus at False Point light-house and found that it had been well set up and was working properly. The next coasting steamer coming in a day before her advertised time, I left on the evening of the 31st and proceeded down the coast in the British India Steam Navigation Company's steamer *India*, touching at Gopalpore, Bimlipatam, and Vizagapatam, and reached Coconada on the 4th April.

26. I remained a few days at Coconada to complete a further examination of the new Godavery channel and make such corrections to the Admiralty chart as should enable the Hydrographer to bring out a new edition. The Port Officer at Coconada was permitted by the Madras Government to place at my disposal the steamer *Lady Mary Grenville*, in which we examined the channels of the Godavery, and found the new deep entrance was improving. The work was delayed till the 15th April, when, owing to the lateness of the season, and the setting-in of the fresh southerly winds, I was not able to examine the Sacramento shoal, with the Pulicat, Armegom, and Devi light-houses, I therefore determined to return to Calcutta.

27. On the 16th April I embarked in the British India Steam Navigation Company's steamer *Himalaga*, and landed at Vizagapatam, where I remained two days to examine the site of the old light-house on the top of Dolphin's Head to ascertain if there were any reasons for not exhibiting a light there now, the apparatus having been destroyed by the cyclone of October 1876. On the 19th I proceeded up the coast in the steamer *Africa*, calling at Calingapatam, where I inspected the light and took bearings to the rocks lately discovered near the

anchorage. On the completion of this inspection I returned to Calcutta on the 23rd April.

Inspection of Marmagao Harbour.

28. Under instructions from the Government of India that I should furnish an additional report upon the proposed harbour of Marmagao, after the Executive Staff of the Marine Survey Department had sectionally sounded the place, I proceeded on the 29th May by rail to Bombay, reaching that port on 1st June, and three days afterwards embarked in the British India Steam Navigation Company's steamer *Chindwara*, which was advertised to call at Goa. On the 6th June the steamer approached the roadstead of Alguada, but the heavy swell prevented any attempt to land by boats, and, owing to the unbuoyed state of Marmagao Bay (where landing would have been quite easy) the commander of the steamer was not allowed to enter that port. Therefore I was carried on to Karwar, where I disembarked. After making arrangements with the Collector about travelling overland to Goa, I started in a dhooly on the 10th June, being obliged to take two full sets of bearers, as there was little probability of finding either bearers or coolies throughout that impoverished Portuguese territory. I remained at Goa till the 16th, when the storms and heavy rain of the south-west monsoon had set in and the land journey back through a country without roads or bridges was rather trying, but I arrived at Karwar on the night of the 18th. The report will be found *in extenso* in Appendix H.

SURVEYING OPERATIONS OF THE SEASON.

Surveying operations carried on by one Survey party owing to paucity of Surveyors.

29. On account of the untimely death of Mr. Morris Chapman, I.N., 1st Grade Assistant, and as it was inadvisable to entertain a survey in the south of India with only two surveyors, the temporary abolition of No. 2 party was sanctioned by the Government of India. The surveying operations of this season were, therefore, carried on not far from Bombay with only one party. The advisability of this measure soon became apparent, as, before active operations commenced, Navigating Lieutenant Jarrad, R.N., Deputy Superintendent, reported that his health was not equal to the arduous field-work of the survey; he was consequently permitted to remain at Bombay to make preliminary arrangements for a fresh thorough survey of certain portions of that harbour, the necessity for which was mentioned in my last year's report.

Navigating Lieutenant E. W. Petley, R.N., Assistant Superintendent in charge.
Lieutenant W. H. Coombs, R.N., Assistant Superintendent.
Navigating Lieutenant T. C. Pascoe, R.N., Assistant Superintendent.
Mr. P. J. Falle, Assistant Superintendent.
Mr. W. H. W. Searle, Assistant Superintendent.
Surgeon J. Armstrong (Bengal Establishment), Medical Officer and Naturalist.

30. The amalgamated party consisted of the officers marginally mentioned, as also one European engineer, 2 native engineers for the steam cutters, 2 tide-watchers, 4 leadsmen, 3 seacunnies, 4 stokers, 6 lascars, one messenger and a clerk. The party was provided with two steam cutters, one whale boat, the necessary tents and surveying gear. The only operations that Lieutenant Jarrad superintended were those in connection with the examination of the floor of the channel leading out of Prince's Dock at Bombay; the other surveys of the season were all superintended by Navigating Lieutenant Petley, R.N.

Instructions to the officer in charge of the Survey party.

31. The following are the instructions issued to the officer in charge of the above-mentioned survey party with reference to the work to be executed. Full particulars of the work accomplished are furnished in section III.

Survey of Karwar.

32. The survey of Karwar, which was to be undertaken for engineering purposes, was to include at first only the port proper; the offshore deep soundings seaward of the Oyster rocks were not required to be taken with our small steam cutters, as they might subsequently be more easily done in the surveying steamer; but the triangulation should now be conveniently extended so as to include the whole of the points, islands, summits of seaboard hills, &c., between Loliem Point on the north and Anjediva Island on the south. The importance of leaving fixed

artificial (such as cairns or beacons) or natural marks for future survey operations was pressed upon the attention of the officer in charge.

Survey of Bankot.

33. The next place to be surveyed was Bankot, and as the river entrance was very similar to that of Dabhol (which was examined and charted last year), the same scale for the chart and the same style of survey was to be adopted.

34. The survey of Karwar was greatly facilitated by the previous establishment of a self-registering tide-gauge in Baitkul cove by Captain Baird, R.E., who was able to give all necessary information as to the tides.

Surveys of the channel leading into Princes Dock, Bombay, and of Goa.

35. The programme of work sanctioned by the Government of India embraced the survey of Karwar, then Bankot, and finally Bombay harbour. But the party had only just reached Bankot on 16th December when the Government of Bombay directed Lieutenant Jarrad to examine the entrance channel into Prince's Dock; in consequence of this, two-thirds of the officers were engaged at Bombay till the 6th January, when Lieutenant Petley resumed work at Bankot. Nothing more was done at Bombay in the last working season, but under orders from the Government of India the party was transferred from Bankot to Goa in the middle of February, the Government of Bombay having reported to the Supreme Government that Mr. Sawyer, C.E., who was entrusted with the survey of the newly-projected line of railway from Marmagao Bay through the Goa territory, had made an application for the aid of a staff of Marine Surveyors to survey Marmagao Bay (Goa), its early completion being urgently necessary.

36. Mr. Sawyer, the Engineer-in-chief, wished the site of the proposed harbour of Marmagao to be sectionally surveyed on two distinct and very large scales—one on 200 feet = one inch, and the other on 300 feet = one inch; the lines of the first being only 25 feet apart, whilst those of the second were 50 feet apart. Mr. Sawyer also wished cross sections to be taken of the hills at about 50 feet apart over the whole extent of land embraced in the plans. This was obviously a land surveyor's work which the Royal Navy surveyors were not called upon to execute. But the other proposal—so far as the soundings were concerned—was carried out; however, owing to the strong north-west winds, which caused a heavy swell in March and April, the whole area of the Bay was not surveyed last season.

Applications made to the Department for the execution of Surveys.

37. Many applications have been made to the Marine Survey Department for the execution of surveys of ports and portions of coast, which, although demanding attention, cannot yet be entertained, as the executive staff of the Department is so short-handed. Some new bays have been discovered by the Commissioner of the Andaman Islands, whilst going on tour, and one excellent strait right through the large island from sea to sea. By permission of Colonel Cadell, V.C., Mr. Allen, the Commander of the I. G. schooner *Constance*, was enabled to make a very creditable survey of Port Mouat, which has been published (see detailed statement at page 16).

Importance of a Naturalist to *Investigator* for researches in Natural History.

38. No Physical or Natural History investigations have been carried on during the past year, in consequence of Dr. Armstrong having been transferred to the general service; the medical charge of the party has, therefore, been placed in the hands of an assistant apothecary. Without a surveying vessel it was perhaps unnecessary to continue the services of the Surgeon and Naturalist, but it is to be hoped that when the steamer *Investigator* is ready, such an officer, with an assistant, as suggested by the Asiatic Society of Bengal, may be re-appointed, in order that the physical work of the department may receive that attention the importance of such labours demands. The subject of the physical exploration of Indian waters has been ably discussed by the above-mentioned society, as I pointed out in my previous report, which has made some valuable suggestions as to the area to be examined, the method to be used in its examination, the due preservation of the specimens obtained, the record of observations, the arrangements necessary for facilitating the examina-

tion and determination of specimens, and the ultimate destination of the collection.

39. The *Investigator* is being specially fitted for such work, and the appliances are now ready stored in Bombay dockyard. I would therefore again impress upon the Government the benefits to be derived from a physical investigation of the Bay of Bengal and Arabian Sea.

Work executed at Head-quarters.

40. My inspection tours necessarily caused long absences from Calcutta; but they did not in any way affect the work at head-quarters. The current business of the Department was ably carried on by Mr. R. C. Carrington, who was appointed by the Government of India and was gazetted to hold charge of the post of Deputy Superintendent, 2nd grade, and my instructions for surveying operations were communicated to him, from time to time, by telegraph or by letter, and were forwarded through the office in the usual official manner to the survey officers. Mr. Carrington has, with the approval of Government, remained in charge of the office at head-quarters during my temporary absences on public duty ever since the departure of Staff Commander Ellis, R.N.

41. The Compiling and Drawing Branch has again accomplished much valuable work, full particulars of which will be found in Section II. The staff of assistants sanctioned for this branch is mentioned in the margin. It will be seen that, during the period under review, eleven new charts have been issued. Several very elaborate sheets have been produced, and reflect great credit on the Superintendent of this branch and the draftsmen under him.

1 Head Draftsman.
1 2nd ditto.
1 3rd ditto.
2 Apprentice Draftsmen.
1 Chart Clerk.
1 Chart Mounter.

42. A large amount of work has been done by the staff of clerks mentioned in the margin employed in the office at head-quarters. The number of official letters and official memoranda, issued during the period embraced in this report, aggregated 2,973, and upwards of 400 demi-official letters were sent out. In addition to these, many lengthy reports regarding subjects referred to me for opinion, as also my reports on the harbours and lights inspected by me, were prepared and furnished to the Government of India.

1 Chief Clerk and Accountant.
1 Clerk.
2 Copyists.

43. A number of nautical questions were forwarded to me by the Governments of India, Madras, Bombay, and Bengal, and the Chief Commissioner of British Burma, and were duly reported on. Among the most important of these were—

System of buoyage for Indian harbours.

On the question of substituting screw-pile light-houses for light-vessels at the Sandheads.

On the survey and buoyage of the Naaf River.

On the best method of carrying out a survey of the Dhumra River.

On the question of laying down and maintaining buoys in the Persian Gulf.

Regarding the erection of a light-house on the Fisherman's rock (Azalea), near Perim.

Regarding the proposed harbour of Marmagao.

On the present condition of False Point harbour and whether it is likely to deteriorate or not.

On the lighting of the entrance to the Rangoon River.

On a proposal of the Port Officer, Calcutta, for altering the direction of the lights at Norman's Point, and a proposal to have a whistling buoy at the South Patch Shoal.

Hydrographic Notices and Notices to Mariners published.

44. During the period under review, nine Hydrographic Notices and twenty-two Notices to Mariners, relating to new lights, buoys, and newly-discovered dangers, have been published. The number of copies of Hydrographic Notices printed during the year amounted to 2,700, and of Notices to Mariners to 8,800; and out of these, 1,850 copies of the former Notices and 6,600 of the latter were forwarded to ninety-eight Indian maritime authorities and foreign Governments. In my previous general reports I informed the Government of India that the publications of the Marine Survey Department are regularly reproduced by all the principal Hydrographic Departments throughout the world.

45. The following table shows the Notices to Mariners and Hydrographic Notices issued between the 1st October 1879 to 30th September 1880 inclusive:—

Number of Notice.	Number of copies printed.	Locality to which Notices refer.	Subject.
1879.		*Notices*	*to Mariners.*
32	400	Ceylon, East Coast . . .	Regarding the light at Batticaloa.
33	400	India, West Coast, Calicut . .	Announcing that two Black Buoys have been laid down in Calicut Roadstead to mark the limits of foul ground.
34	400	Ceylon, East Coast . . .	Regarding the light at Batticaloa.
35	400	India, West Coast, Carwar . .	Notifying that all the buoys marking the rocks at Carwar have been replaced in position.
36	400	Gulf of Aden	Stating that a telegraph buoy lies south of Aden in latitude 12° 32′ 10″ N., longitude 45° 5′ 15″ E., also that a smaller buoy lies two miles to the south of the above given position.
37	400	Bay of Bengal, Godavery District, Cocanada.	Regarding the Black Buoy off Point Gordeware (Godavery).
38	400	Ceylon, East Coast . . .	Announcing that the light at Batticaloa will be exhibited throughout the year from sunset to sunrise.
39	400	Red Sea, Gulf of Suez . . .	Respecting the exhibition of a light on the north shore of Suez Bay, as a leading light through the deep water channel westward of Newport rock, and the channel near the spit buoy, thence to the anchorage, in about 5 fathoms water.
40	400	Bay of Bengal, Coromandel Coast .	Notifying that the Semaphore on the Marine Office flagstaff is now dropped at 8 A. M. and 2 P. M. daily, Madras meantime.
41	400	Bay of Bengal, Godavery District, Cocanada.	Regarding the Black Buoy off Point Gordeware (Godavery).
42	400	Bay of Bengal, Coromandel Coast .	Stating that when the Semaphore on the Marine Office flagstaff does not drop correctly, signal C. V. N. J. of the Commercial Code will be hoisted immediately and kept flying for half an hour.
43	400	India, West Coast	Respecting the buoys at Calicut.
1880.			
1	400	Africa, East Coast, Zanzibar Harbour.	Relative to the prohibited anchorage in the vicinity of the telegraph cables in Zanzibar Harbour.
2	400	Bay of Bengal, Coast of Burma, Gulf of Martaban.	Notifying the discontinuance of the exhibition of *maroon* lights from the Krishna Shoal light-vessel.
3	400	Bay of Bengal, Coast of Orissa .	Announcing the exhibition of a new *fixed white* light at False Point.
4	400	India, Bay of Bengal . . .	Regarding the extension of the period during which the light is exhibited from the "Intermediate" light-vessel at the entrance to Hooghly River.
5	400	China Sea, Singapore . . .	Notifying the alterations made in the position and visibility of the light exhibited from Fort Canning, Singapore.
6	400	Malabar Coast, Cannanore . .	Stating that the red light at Cannanore will be exhibited from a stone structure erected on the ramparts of the fort, near the flagstaff, and that the light will be elevated 64 feet above the sea.

Number of Notice.	Number of copies printed.	Locality to which Notices refer.	Subject.
1880.		*Notices to Mariners*—continued.	
7	400	India, Bay of Bengal . . .	Regarding the discontinuance of the exhibitions of maroons from the light-vessels at the entrance to the Hooghly River.
8	400	India, West Coast, Dabhol or Anjanvel.	Relative to the exhibition of a fixed white light on Tolkeshwar headland (the south shore of Dabhol Creek, known also as Anjanvel or Gopalgad Creek).
9	400	Red Sea, Gulf of Suez . . .	Regarding the lights exhibited at Port Ibrahim, Suez Bay.
10	400	Bay of Bengal, Coromandel Coast .	Respecting the changes in the buoyage of the port of Madras.
		Hydrographic Notices.	
15	300	South Indian Ocean . . .	Relating to Seychelle and Farquhar Islands, also to Port Robinson, Madagascar.
16	300	Torres Strait and New Guinea, South East Coast.	Regarding Torres Strait, Prince of Wales' Channel and Great North East Channel; also to New Guinea, South East Coast and Louisiade Archipelago.
17	300	India, West Coast	Respecting Ratnagiri, Rajapur Bay, and Viziadurg.
18	300	Bay of Bengal, Siam Coast . .	Navigation, Pakchan River, Thalang (Salang), or Junkseylon Island, islands eastward of Junkseylon, &c.
19	300	Africa, East Coast . . .	Relating to Pemba Island and the adjacent coast between Tanga Bay and Chola Island, with directions for Pemba Channel.
20	300	India, West Coast	Regarding the coast from Kundari Island to Chaul, and the Harbours of Dabhol and Jaygad.
21	300	Arabian Coast	Regarding shoal ground off the east coast of Barr-al-Katir.
22	300	Red Sea	Navigation, Suez Bay.
23	300	Bay of Bengal, Coast of Orissa .	Respecting False Point Harbour.

Issue of a small list of light-houses and light-vessels on the coasts of British India.

46. A small list of the light-houses and light-vessels in British India, including the Red Sea and Coast of Arabia, was prepared and issued by the Marine Survey Department during the year. This is an important contribution to Indian nautical publications, and is corrected annually; the astronomical positions are carefully considered and various alterations and additions are made from time to time, embracing the latest information that can be obtained from the various Marine authorities at all stations between Suez and Singapore.

Wreck Return.

47. A Return of Wrecks and Casualties in Indian waters during the year 1879 was prepared and issued by Mr. R. C. Carrington, the Registrar of Wrecks. This important publication is highly appreciated by the Mercantile Marine, and the public press, both at home and in India, have been unanimous in expressions of praise regarding the careful manner in which it was compiled. The information necessary for the compilation of this return was regularly furnished to this office by the various Marine authorities, Master Attendants, Port Officers, &c., who also courteously supplied Mr. Carrington with valuable meteorological memoranda, which enabled him to make the return much more elaborate and comprehensive than those previously issued. The review by which this return is prefaced is drawn up by the Registrar of Wrecks, and is carefully revised by me prior to its submission to the Government of India. It is hardly necessary for me to direct the attention of the Government of India to the great difference existing between the Wreck and Casualty Returns formerly published and those now issued from this Department.

Number of publications issued by the Department since the date on which work was commenced at head-quarters.

48. From Appendix J it will be seen that since April 1875, the date on which work was commenced at head-quarters, till the 30th September 1880, 59 new charts have been published, and 24 Hydrographic Notices, 141 Notices to Mariners, 4 editions of the Return of Wrecks and Casualties in Indian waters (1876 to 1879), 5 editions of the List of Lighthouses and Light-vessels in British India (1876 to 1880), and various other useful publications, including spheroidal tables, Glossary of French terms, tables of natural scales, table of distances at which objects are seen at sea, &c., have been issued for the benefit of the nautical community.

The Chart Depôt at Calcutta

49. The Chart Depôt established in Calcutta has worked satisfactorily and is much appreciated by English and foreign masters of vessels and the various shipping agencies in Calcutta, Madras, and Bombay. Lists of all new charts and hydrographic publications, and information as to where these productions are to be purchased, were printed in English, Urdu, Arabic, Persian, Bengali, Tamil, Telugu, Mahrathi, and Guzerathi, and were distributed by us to the shipping agencies in the above presidencies and in British Burma. Copies were also sent to the various Port Officers and Harbour Masters on the coasts of British India; to Her Majesty's Political Residents at Bushire, Muskat, Cutch, and Rajkote, as also to shipping agencies at Baghdad, Bussorah, Jiddah, Bushire, and Muskat, and were widely circulated among nacodahs and tindals of native craft at those and other minor ports. The result is highly satisfactory, for not only has the sale of charts increased, but a large number of masters and owners of native craft come now to the Department for information concerning their own coasts.

50. The various shipping agencies in Calcutta have been informed that the Marine Survey Department are quite willing to overhaul any set of charts belonging to any ship in this port free of charge, and give the necessary information relating to the seas which they may have to navigate, and Masters of vessels, including nacodahs and tindals of native craft, now come up into this office to make enquiries on all points connected with navigation, routes, winds, currents, magnetic variation, and also to have their charts examined in order that they may have their incorrect or obsolete copies replaced by later publications. In several instances most important corrections or additions have been made. Notably a steam vessel which arrived here a short time ago, supposed to have been supplied with the latest charts in England, had as many as half a dozen obsolete and incorrect sheets on board, and these referring to Indian waters.

51. The following statement shows the number of copies of charts issued from this Department during the year 1879-80 (*i. e.*, from 1st October 1879 to 30th September 1880) for the use of Her Majesty's and Indian Government ships and the various Marine authorities throughout the world:—

	No. of copies.
Supplied to Her Majesty's and Indian Governments	273
Supplied to Foreign, Colonial and Local Governments	175
Presented to Geographical Societies, Survey Departments, Superintending Engineers, &c.	275
Supplied to Her Majesty's and Indian Government Ships	297
Supplied for official use to the Superintendents of Marine, the various Master Attendants, Port Officers, Harbour Masters, and other Marine authorities in India	570
Presented to the various Hydrographic Departments throughout the world	39
Supplied on commission sale	1,549
Supplied gratuitously to Members of the Pilot Service	38
Supplied to the Superintendent of Marine Surveys, whilst on official tours, to the Marine Survey parties, and for office use in the construction of new Charts	163
TOTAL	3,379

52. Of this number, 2,152 were copies of charts produced at the Marine Survey Department, and the remainder, 1,227, were Admiralty charts.

During the period under review the following sales of charts, &c., were effected:—

	Number of copies.	R.	A.	P.
Indian Marine Survey Charts	1,099			
Admiralty Charts	630			
TOTAL .	1,729	2,094	6	3
Books and other publications, such as Hydrographic Notices, Notices to Mariners, Light Lists, &c. .	2,043	237	11	0
TOTAL AMOUNT REALISED BY THE SALE OF CHARTS, &c.		2,332	1	3

Official changes and good services of the Officers of the Department.

53. On the abolition of the Department of Revenue, Agriculture, and Commerce in August 1879, the Marine Survey Department was placed under the Military (Marine) Department.

54. Under orders of the Government of India, the services of Surgeon J. Armstrong, Medical Officer and Naturalist, were transferred to the Medical Department on the 27th April 1880. Navigating Lieutenant Pascoe, R.N., returned from privilege leave in the end of October 1879.

55. The services of Navigating Lieutenant Jarrad, R.N., Deputy Superintendent, were placed by the Government of India at the disposal of the Admiralty on the 7th February 1880, and that officer, after taking three months' privilege leave, finally left India on the 18th April 1880.

56. Owing to Lieutenant Jarrad's state of health, Navigating Lieutenant Petley, R.N., Assistant Superintendent, 1st Grade, had charge of all the survey operations of the season (with the exception of the examination of the bed of the channel into Prince's Dock). Lieutenant Petley has conducted the surveys to my satisfaction, and is a most hardworking officer. He deserves great credit for his elaborate survey of Marmagao anchorage, which was executed at a very hot and trying season of the year when the officers and men were frequently prostrated with fever. The officers mentioned in the margin have also done good service.

Lieutenant Coombs. Navigating Lieutenant Pascoe.	Mr. P. J. Falle. Mr. Searle.

57. I have again to record my high appreciation of the valuable services of Mr. Carrington in conducting the duties of the Chart Branch. He has also rendered me the greatest assistance in carrying on the office work,* when I was absent on tours of inspection of all light-houses, at which time he was in charge of the office. The compilation of the Annual Wreck Return with illustrative chart involves much labour and evidences his business habits and earnest desire to remove all hindrances to safe navigation. As already pointed out, Masters of vessels, including nacodahs and tindals of native craft, come to the office for information on many subjects connected with the navigation of these seas, and it is now very necessary that an officer well versed in such subjects should be constantly at the Department to meet the wants of the maritime public. Having no assistant, Mr. Carrington has denied himself any leave of absence during his service of six years.

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* Mr. Donald Sunder, Chief Clerk and Accountant, has been most painstaking and untiring in the execution of his many increasing labours. With the various extraneous duties which this Department has been called upon to perform, the correspondence is multiplied and the Chief Clerk has worked beyond office hours, being so anxious that his work should not get in arrears.

Staff of the Marine Survey of India.

58. On the 30th September 1880 the strength of the Marine Survey Department was as follows:—

Superintendent of Marine Surveys . . Commander A. Dundas Taylor, I.N., F.R.G.S.

Superintendent's Office.

Superintendent, Compiling and Drawing Branch.	Robert C. Carrington, Esq. F.R.A.S. F.R.S.L., A.I.C.E.
Chief Clerk and Accountant	Mr. Donald Sunder.
Clerk	Ishan Chunder Das.
Copyists	Bidhoo Bhushun Dey. Mr. R. Lumsden.
Head Draftsman	Kally Dass Seal.
2nd Draftsman	Mr. Thomas Ribeiro.
3rd ,,	Mr. Thomas Smith.
Apprentice Draftsman	Rajendro Nath Palit.
,, ,,	Pulin Behary Dutt.
Chart Clerk	Mr. C. Thielmann.
Chart Mounter	Kally Doss Dhur.

One duftary, one duffadar, four peons, and two menials.

Executive Staff Scientific Officers.

Vacant	Deputy Superintendent, 1st Grade.
Navigating Lieutenant E. W. Petley, R.N., F.R.G.S.	Assistant Superintendent, 1st Grade, in charge of No. 1 Survey Party.
Vacant	Assistant Superintendent, 1st Grade.
,,	Assistant Superintendent, 1st Grade.
Lieutenant W. H. Coombs, R.N.	Assistant Superintendent, 2nd grade attached to No. 1 Party.
Navigating Lieutenant T. C. Pascoe, R.N.	Assistant Superintendent, 2nd Grade, attached to No. 1 Party.
P. J. Falle, Esq.	Assistant Superindendent, 2nd Grade, attached to No. 1 Party.
Vacant	Assistant Superintendent, 2nd Grade.
W. H. W. Searle, Esq.	Offg. Assistant Superintendent, 3rd Grade, attached to No. 1 Party.
Vacant	Assistant Superintendent, 3rd Grade.
,,	Executive Officer.
,,	Executive Officer.
,,	Executive Officer.

A. DUNDAS TAYLOR, *Commander (late I. N.),*
Superintendent, Marine Survey of India.

SECTION II.

COMPILING AND DRAWING BRANCH.

The Superintendent of this branch (Mr. Carrington) reports that from 1st October 1879 to 30th September 1880 several very elaborate sheets have been produced, amongst others may be mentioned those showing the results of the surveys on the west coast of India, such as Jaygad, Kundari Island to Chaul, Dabhol and the entrance to the Washishti River, and others; a useful plan of Saláya (Seraia,) in the Gulf of Cutch, has been compiled from my own observations and the Great Trigonometrical Survey sheets; a new plan of the hitherto unsurveyed harbour of Port Mouat in the Andamans has also been prepared from a survey by Mr. F. W. Allen, commanding the Indian Government steamer *Constance*. A skeleton track chart of the Indian Ocean from Suez to Penang, and including Zanzibar and Madagascar, which will contain the names of all the Indian ports, and on which is also to be shown plans of the oceanic currents, surface temperatures and lines of equal magnetic variation, has been compiled and is now being engraved at the Office of the Surveyor General. A new sheet showing the late changes at False Point Harbour, and three new charts on a large scale, giving the results of Commander Loftus's surveys on the Siam coast, have also been published.

Amongst Mr. Carrington's compilations of the past year perhaps one of the most useful charts is the general sheet of the Arabian Sea, which has been badly wanted and much sought after by ship captains for many years past. It has been compiled from the best existing materials and will be a really valuable addition to cartography. Its utility will be further enhanced by the plans which have been inserted, on the land portions of the sheet, of the principal ports, such as Bombay, Kurrachee, Colombo, Galle, Madras, Straits of Babel Mandeb, &c. This is a heavy piece of work, but it is hoped the chart will be shortly in the printer's hands.

Lately we have also produced small charts of Moelitivo and Batticaloa, the latter port being now frequently visited by the British India steamers. But in the interests of commercial navigation, a thorough survey is urgently called for of the Pedro shoals and of all the banks between Point Calimere and Kangasenthoray, the S. W. monsoon anchorage for the port of Jafnapatam.

The drawing of the various charts has been good, and in the case of the head draftsman of a very superior description. Mr Carrington reports that all the draftsmen employed have given satisfaction.*

During the period under review eleven new charts have been published, from which 4,130 copies have been printed, by the photozincographic process, at the Office of the Surveyor General of India; 10,088 copies of Admiralty and Marine Survey Department charts were corrected by hand, for new, or alterations to, lights, buoys, beacons or recently discovered dangers to navigation; and upwards of 2,000 copies of charts coloured. British, Foreign and Colonial Notices to Mariners and Hydrographic Notices have been examined and, where necessary, translated; they afford the data for the correction of charts stored in the Department, and the examination of these notices, as well as of careful insertion of corrections on office copies, forms one of the most important and responsible duties of the officer who superintends the chart branch. The various Hydrographical Offices and Marine Departments throughout the world have furnished this department with 1,476 such Notices, England having contributed 303, America 274, Austria and Germany (Kundmachung für Seefahrer, and Hydrografische Nachrict) 114, Holland (Berigt aan Zeevarenden) 61, France (Annonce Hydrographique) 443, Spain (Aviso à los Navegantes) 153, China 30, the Indian Government 22, and the Australian, New Zealand, and Dutch Netherlands Governments 76.

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* Baboo Kally Das Seal, the chief draftsman, again deserves to be specially mentioned for his good, careful work. Mr. T. Smith has also turned out some excellent drawing.

Mr. T. Rebeiro has worked hard and carefully, and materially assisted the Registrar of Wrecks in the preparation of the Annual Wreck Returns.

Mr. C. Thielmann, the chart clerk, has given great satisfaction; his knowledge of the distribution of the charts, and his steady, business-like habits, render him a most useful assistant.

The "Return of Wrecks and Casualties in Indian Waters" for 1879 was published in June 1880. Mr. Carrington's endeavours to make this return a reliable official record have been fully recognised by the Government of India. The meteorological memoranda and observations recorded at the principal Indian ports, forming the Appendix to the Report, are of decided value to navigation, and will be utilised by this Department in the compilation of sailing directions.

The fifth edition of the List of "Light-houses and light-vessels in British India" with map, was published in the early part of the year; the work was corrected from official information to the 1st February 1880.

The following statement shows in detail the amount of work performed in this Branch from the 1st October 1879 to the 30th September 1880.

Number of Chart.	Title.	Size.	Scale.	Remarks.
1233	Jaygad (Jyghur) and entrance to Shástri river.	D. E.	M = 6·0	400 copies photozincographed. Prepared for publication from the surveys executed in 1879 by Navigating Lieutenants F. W. Jarrad, E. W. Petley, T. C. Pascoe, R.N., and Mr. P. J. Falle; officers employed in the Marine Survey of India. The whole space embraced within the limits of the chart has been examined in great detail.
1231	Kundari Island to Chaul ...	Atlas	M = 2·0	400 copies photozincographed. Do. do.
	Index Map of India ...	$\frac{\text{D. E.}}{8}$	D = 0·50	300 copies photozincographed. To accompany the General Report. Showing the surveys completed by the officers of the Marine Survey Department, and sheets published from the results of these surveys, and those compiled from other authorities.
171	Port Mouat, Andamans ...	Atlas	M = 11·16	250 copies photozincographed. An excellent plan of this hitherto unsurveyed port. The survey was executed by Mr. F. W. Allen, Commanding the Indian Government schooner *Constance*. A key plan has been added to the sheet, showing the approaches to the port, by which it will be seen that the details of all former charts were greatly in error.
25	Saláya (Seraia)	$\frac{\text{D. E.}}{2}$	M = 1·0	300 copies photozincographed. Compiled from an examination by Commander A. D. Taylor, and the Great Trigonometrical Kattywar survey sheets, 1879. Hitherto there has been no chart of this excellent port.
1182	Langsuen Roads	$\frac{\text{D. E.}}{2}$	M = 1·2	350 copies photozincographed. This plan was much needed locally. It has been published from the survey executed in 1872 by Commander A. J. Loftus, of the Siamese Navy. No large-scale chart has hitherto existed of this portion of the coast of Siam.
63	Sedashivgad Bay, including the port of Karwar and Beitkul cove.	D. E.	M = 6·0	*In progress.* Shows the results of the survey in 1880 by Navigating Lieutenant E. W. Petley, Lieutenant W. H. Coombs, Navigating Lieutenant T. C. Pascoe, R.N., and Messrs. P. J. Falle and W. H. W. Searle—officers employed in the Marine Survey of India.
1252	Bankot and entrance to Savitri river.	D. E.	M = 6·0	Do. do. do.

Number of Charts.	Title.	Size.	Scale.	Remarks.
	Wreck chart of the coasts of India and Burma from Suez to Penang, including Zanzibar and Madagascar.	D. E.	D = 0·5	Now being engraved at the Surveyor General's Office. The sheet has been compiled from the latest Indian and Admiralty charts; it can be utilised as a track chart or for recording physical observations; but the principal object of its production is to have a good sheet, which will embrace the limits of so-called Indian waters, in which wrecks and casualties are reported and recorded. A large number of the smaller Indian ports has been given on this sheet, for general reference, which do not appear on existing charts. Separate key plans have been inserted on the spare spaces of the sheet, showing the oceanic currents during the N. E. and S. W. monsoons; as also the lines of equal temperature of the surface water, and of equal magnetic variation throughout the Indian Ocean.
1232	Chaul and Entrance to Kundalika River.	D.E.	M=6·0	480 copies photozincographed. Prepared for publication from the original drawing showing the results of the survey executed in 1879 by Navigating Lieutenants F. W. Jarrad, E. W. Petley, T. C. Pascoe, R.N., and Mr. P. J. Falle, officers employed in the Marine Survey of India.
1165	False Point Harbour and its Approaches.	D.E.	M=3·0 plan. M=6·0	250 copies photozincographed. Compiled from Navigating Lieutenant Hammond's Survey 1876, and Commander Taylor's observations and corrections, 1880. This sheet embraces the coast between the South Broni River on the north, and the southern entrance to the Mahanadi River on the south. It shows the Approaches to the harbour from every direction seaward, includes False Point light-house and the Bacood and Jamboo creeks. A key plan of the extreme Sandy Point (Reddie head), showing the anchorage on a large scale, has been inserted on this chart.
1257	Arabian Sea. Western portion ...	D.E.	D=1·0	*In progress.* These two sheets will include Ceylon, the Gulf of Persia, a portion of the Red sea, and Zanzibar. Large-scale plans of the following ports will be inserted in the spare spaces, *viz.*, Bombay, Karrachee, Colombo, Galle, Madras, Perim Strait and Zanzibar. There is at present no good navigating chart of the Arabian Sea. These sheets have been compiled from the latest charts issued by the Marine Survey Department and the British Admiralty. The names of all ports on the Indian Coasts have been inserted and the authorized orthography has been followed. The want of a good chart of this portion of the Indian Ocean has been sorely felt.
1257*a*	Ditto Eastern portion ...	D.E.	D=1·0	
1234	Dabhol and Entrance to Wáshishti River.	D.E.	M=6·0	400 copies photozincographed. Prepared for publication from the original drawing showing the results of the survey executed in 1879 by Navigating Lieutenants F. W. Jarrad E. W. Petley, T. C. Pascoe, R.N., and Mr. P. J. Falle,—Officers employed in the Marine Survey of India. This sheet supersedes the chart of Anjenwil, originally published by the E. I. Company and subsequently issued at the Admiralty.
1181	Samuie Strait (Gulf of Siam) ...	D.E.	M=1·2	350 copies photozincographed. This chart was prepared for publication from the original drawings showing the result of Commander A. J. Loftus' survey in 1872. This sheet shows, in detail, a portion of the coast of Siam hitherto but little known. The work has been adapted to the latest reliable astronomical determinations, and the general appearance of the land, when approaching the coast, is given in the views on the chart.

Number of chart.	Title.	Size.	Scale.	Remarks.
1180	Lacon Roads	D.E./3	M=0·85	350 copies photozincographed. Prepared for publication from the original drawings showing the result of Commander A. J. Loftus's survey of 1872. No large-scale plan of this roadstead has hitherto existed.
	Index Chart of Light-houses and Light-vessels in British India for 1880.	D.E./8	D=0·25	300 copies photozincographed. Bound up with the new edition of the "Light-houses of India."
	Cape Comorin to Point Calimere, including the Island of Ceylon, with plans.	D.E.	M=0·10	*In progress.* It is intended that the sheet shall embrace the whole of the island of Ceylon. A good general chart of the island, with the adjacent coast, is much needed. Large-scale plans of Galle, Colombo, Trincomalee, &c., will be inserted on the spare spaces of the sheet.
	Gulf of Cambay	D.E.	M=0·50	*In progress.* The present chart of the Gulf is a most erroneous one, not only in the hydrographic details, but the coast is greatly in error, and has never been adapted to the positions determined by the Great Trigonometrical Survey. Elaborate surveys within the coast line have been made, and the results published at the Surveyor General's Office, and these will be utilized in this compilation, the hydrographic portion to be inserted, from time to time, as it reaches this office.

Miscellaneous.	For what purpose executed.
Additions and corrections to the new sheet of Tuticorin Roadstead by the Port Officer and Captain Baird.	For photozincography.
Additions to the originals of Paumben Pass, Nos. 95 and 1184 by Mr. Chapman, late I.N., and Port Officer.	Ditto.
Touching up drawings of new species of hydroid zoophytes, by Surgeon J. Armstrong.	For the General Report for 1878-79.
Reduction of chart of the approaches to Port Mouat, by F. W. Allen, I. G. S. *Constance.*	For compilation of Port Mouat sheet.
Tracing of Bate Harbour, with corrections, by Commander Taylor.	For Government of Baroda.
Four copies of Commander Taylor's proposals for the improvement of False Point anchorage.	To accompany Commander Taylor's report, and also for office use.
Reduction of the latest Admiralty and Marine Survey Department sheets.	For compilation of Wreck and Casualty chart.
Corrections to Admiralty charts 832, 822, and Marine Survey Department sheets 1165 and 1172, by Commander Taylor.	For transmission to the Hydrographer to the Admiralty.
Tracing of sketch of North Sentinel Island, by F. W. Allen, I. G. S. *Constance.*	Ditto ditto.
Six copies of Commander Taylor's corrections to the sheets of Cocanada and False Point Harbour.	To accompany Commander Taylor's report.
Enlarged sheet 94 of the Atlas sheet of India ...	For additions to chart of Coconada Bay.
Additions to the original drawing of Quilon Roads, by Commander Taylor.	For photozincography.
Two copies of Commander Taylor's sketch on the grounding of the S. S. *Chinsurah* at False Point Harbour.	For office reference.
Additions to Admiralty sheet 825, by Commander Taylor. .	For transmission to the Hydrographer to the Admiralty.
Tracing of a portion of Marine Survey Department sheet 1231.	Ditto ditto.
Tracing of sheet of Bate Harbour, showing corrections, by Commander Taylor.	For transmission to the Hydrographer to the Admiralty, and also for office use.

Miscellaneous.	For what purpose executed.
Tracing of portion of Fell's passage, Mergui ...	To accompany Commander Taylor's report.
Three copies of Commander Taylor's corrections to the sheet of Gulf of Cambay.	For submission to the Government of Bombay.
Two copies of enlargement of Revenue survey maps of Cheduba and Ramree, showing Commander Taylor's corrections to Sandoway.	For transmission to the Hydrographer to the Admiralty and also for office use.
Two copies of Commander Taylor's corrections to False Point Harbour.	For submission to the Government.
Corrections to Cocanada Bay, by Commander Taylor ...	For office use.
Reduction of three sheets of Commander Loftus' Siam Coast survey.	Used in the compilation of sheets of Samuie Straits and Lacon and Langsuen Roads.
Additions to the original drawing of Orissa coast sheet, by Commander Taylor.	For photozincography.
Copy of Commander Taylor's additions to False Point Harbour.	For submission to Government, and also for transmission to the Hydrographer to the Admiralty.
Wreck chart showing the wrecks and casualties that have occurred on the coasts of India and Burma for 1879.	For binding up with the Wreck Return.
Copy of False Point Harbour limits, by Commander Taylor.	For Commissioner, Cuttack Division.
Corrections to Admiralty chart 216 A and B ...	For transmission to the Hydrographer to the Admiralty.
Four copies of portions of Admiralty charts showing new survey of Goa and Marmagao Roadstead, by Navigating Lieutenant Petley.	For Government of India, and also for Lieutenant Petley.
Tracing of portion of Bombay "Entrance to Princes Dock," by Navigating Lieutenant Jarrad.	For the Government of India.
Obtaining means of meteorological observations recorded at the various ports of India for 1879.	For the Wreck Return.
Copy of Mr. Laycock's sheet of River Hooghly showing the entrance to Hidgelee River.	For office copy.
copies of corrections to Admiralty sheets 242 and 243, showing proposed break-waters, by Commander Taylor.	For the Government of India, and also for office use.
Copy of portions of sheets 740 and 743, showing proposed new survey.	For Navigating Lieutenant Petley.
Three copies of specimen of automatic signal buoys ...	For office use.
Reduction of plan of Port Mouat (South Andaman), also Admiralty sheets.	For compilation of Port Mouat sheet.
Two copies of Commander Taylor's additions to Cocanada and Coringa Bays.	For Commander Taylor's use.
Tracing of portion of Mr. Chapman's original of Paumben Pass for beacons, additional soundings, &c.	For Port Officer, Paumben.
Tracing of entrance to Sedashivgad River and bar, including the Kalee Nuddee.	For Navigating Lieutenant Petley.
Corrections to Madras sheet showing the Harbour works extension by Master Attendant and Commander Taylor.	For office use, and also for correction of charts.
Additions to the original of Colombo Harbour.	For photozincography.

SECTION III.

SURVEY OPERATIONS, SEASON 1879-80.

WEST COAST OF INDIA.

In accordance with the programme of work submitted by me in July and sanctioned by the Government of India, the following operations were carried out between 1st October 1879 and 30th September 1880, during which period all the surveyors were amalgamated into one party. Navigating Lieutenant Jarrad, having reported himself as unequal to carrying on the field-work on account of impaired health, was permitted to remain at Bombay, and I consequently deputed Navigating Lieutenant Petley to Karwar to proceed with the more minute examination of that port.

Having made all necessary arrangements, and obtaining the services of the Steamer *May Frere,* Navigating Lieutenant Petley embarked his party and boats on the 19th and arrived at Karwar on the 21st October. Lieutenant Coombs, R.N., and Mr. Searle had previously reached that port from Beypore with their steam-cutter and a portion of No. 2 Party; the temporary abolition of this party was due to the untimely death of Mr. Morris Chapman, and consequently the surveys of Beypore and Cochin had to be abandoned for the present. This is much to be deplored, as Colonel Thomason, R.E., under the orders of Sir Andrew Clarke, the Minister of Public Works, much required a more exhaustive survey of those two ports, embracing the set of the ocean and tidal currents, with the ulterior object of projecting harbour works.

With the combined parties Navigating Lieutenant Petley commenced operations at Karwar, secured office accommodation and pitched a camp at Aliguda; Mr. Westbrook, the Port Officer, giving every assistance in completing arrangements.

The party, consisting of the officers and establishment marginally mentioned, commenced surveying operations on 25th October, having two steam-cutters and two gigs, one of the latter being made available for survey purposes through the courtesy of the Port Officer. A base was measured on the sand between the Kalinadi River and Beitkul Cove, and the main triangulation was proceeded with; but this was much delayed by the high dense jungle which covers the summit of the hills and had to be cleared by numbers of coolies —an operation that lasted several days. Owing to the late period to which the rainy monsoon continued, there was much malaria in the jungle, and the health of the party suffered severely from fever; in fact, during the entire Karwar survey, one or more of the officers was often prostrated with fever—a circumstance that greatly retarded the work of the survey and at times almost suspended it.

Navigating Lieutenant E. W. Petley, R.N., Assistant Superintendent, 1st grade, in acting charge.

Lieutenant W. H. Coombs, R.N., Assistant Superintendent, 2nd grade.

Navigating Lieutenant T. C. Pascoe, R.N., Assistant Superintendent, 2nd grade.

Mr. P. J. Falle, Assistant Superintendent, 2nd grade.

Mr. W. H. W. Searle, Officiating Assistant Superintendent, 3rd grade.

Surgeon J. Armstrong (B. A.) F.L.S. Medical Officer and Naturalist.

1 native Surveyor.
1 engineer.
2 stoker Syrangs.
4 stokers.
3 sookanies.
4 leadsmen.
2 tide watchers.
5 lascars.
2 cooks.
1 clerk.
1 peon.
1 taxidermist.

KARWAR.

The survey of Karwar was plotted on a scale of six inches to one nautic mile, showing the topography and shore details of the port proper. This large-scale survey of Karwar bay (Sadashivgad) including Beitkul cove and Karwar head, as also the Oyster rocks and adjacent islands, was executed at the request of the Government of Bombay and of Colonel Thomason, R.E.; but owing to a paucity of officers, and the sickness of many of the party, the observations upon the actual set of the tidal streams and oceanic currents could not be undertaken during that year.

It was not considered necessary, nor did time allow, to carry the survey to the north extreme of Karwar Bay, which is in Portuguese territory, nor could the soundings be carried to any great distance seaward with the small steam-cutters belonging to the department; neither could the examination be extended to the southward of the port so as to comprehend the Island of Anjidiva, which forms a place of shelter against the stormy weather of the S. W. Monsoon, in the immediate neighbourhood of Karwar. The area surveyed in Karwar Bay was 15½ square miles of water and 25 miles of coast line triangulated and charted in detail. The soundings extended about 4½ miles off shore to a depth of 8 fathoms; the inshore bottoms consisted of sand, the outer were olive green and black mud interspersed with isolated rocks, cropping up here and there. The dangerous spots are buoyed, and during the fair season there is little or no danger; but in the S. W. Monsoon these buoys frequently break away, and their absence necessitates great care and attention on the part of navigators. The weather during the working season was generally fair for surveying operations, except in the afternoons, when the sea breeze set in fresh, and the boats being so small, could not be used outside the shelter of Karwar head.

The tidal observations were obtained from Captain Baird, R.E., Superintendent of Tidal and Levelling Operations, whose self-registering gauge has been working at Beitkul Cove for some time. One good result of this survey has been to establish the non-existence of Marriott's rock which had been reported by a former port officer as lying 90 yards off the west point of the Cove, and was therefore inserted on the Admiralty chart of Karwar about 15 years ago. On the Karwar rock, one of the outer dangers, Lieutenant Petley found only 9 feet at low water: this rock was formerly supposed to carry not less than 14 feet. The new survey also shows that the Kalinadi River mouth has altered and deteriorated considerably since my survey executed 25 years ago. In fact, there is now no deep channel into the river, and but the same depth in the best entrance at high water as there was formerly at low water.

BANKOT.

The Survey of Karwar being competed in the middle of December, the party left for Bankot in the I. G. S. *May Frere*, arriving there on 16th December. After landing the stores, making usual provision for housing the men, arranging with local officials for daily food supplies and other requirements of the survey party, Lieutenant Petley was summoned to Bombay with Lieutenant Pascoe and Mr. Falle, and a moiety of the boat party, as the Government of Bombay had instructed Lieutenant Jarrad to make an immediate examination of the North Channel leading into Prince's Dock, previous to its being opened to shipping on the 1st January 1880, by Sir R. Temple. Lieutenant Coombs and Mr. Searle, however, remained at Bankot to commence the triangulation of the port.

PRINCE'S DOCK (BOMBAY).

This survey of the north approach to the Prince's Dock at Bombay consisted principally of "Sweeping" for rocky lumps, and by this means the exact state of the floor of the channel (which had been blasted and dredged out by the Port Trust Engineers) was ascertained throughout a distance of 2,500 feet from the frontage of the dock. The "sweep" used was an iron bar of railway iron, 25 feet in length; this was lowered to a depth (regulated according to the state of the tide) of 12 feet at low water ordinary spring tides, standard low water of the Port Trust surveys, corresponding to a height of 60 feet on the Town Hall datum. The sweep, hung from a steam launch, was taken successively over every part of the channel in sections, 10 feet apart, and thus the smallest inequality in depth was detected and noted. Some rocky patches were discovered, one with only 11 feet over it, and consequently the draught of vessels entering was limited to 20 feet at that time.

BANKOT SURVEY (RESUMED).

The Prince's Dock Survey being completed for present purposes on the 6th January 1880, Lieutenant Petley resumed the survey of Bankot on a scale of 6 inches to a nautic mile. The area surveyed was 15½ miles of coast line triangulated and mapped, and 11¼ square miles of water carefully sounded in sections. The soundings were reduced to the lower low water of ordinary spring tides, the plane of reference being 22·10 feet below the bench mark cut on the face of a pucka built well close to Panbruj Fort. Tidal observations were continued day and night during the whole time the party remained at Bankot.

MARMAGAO (GOA).

In the middle of February, the party having finished Bankot, were conveyed to Goa in the I. G. S. *May Frere* consequent on orders received from the Government of India to make a rigid examination of the port of Marmagao to meet the requirements of the Bombay Government, as suggested by Mr. Sawyer, the Engineer-in-Chief of the proposed Hubli-Marmagao Railway. The surveying operations commenced on the 25th February, and continued throughout the remainder of the fair season till the end of the first week in May. The area surveyed consisted of 3¼ square miles of water most minutely examined, the soundings from the Marmagao Fortress extended over 1,100 yards eastward and about 1,400 yards seaward, and were taken in very close sections of 25 feet apart. This thorough examination of the roadstead discovered a dangerous rock, carrying only 13 feet water, amongst the general soundings of 20 feet; this rock lies E. by N. and 500 yards from the landing jetty. The remainder of the survey extended as far east as Alperquiries head, and about 1,800 yards seaward; this portion was also sectionally sounded, the lines being 50 feet apart. Other and deeper soundings westward of the fortress were carried 3,000 yards seaward and were taken in lines 100 feet apart.

The soundings were reduced to the lower low water of ordinary spring tides, the plane of reference being 15·26 feet below the bench mark cut in the face of the gateway at the landing jetty at Marmagao. The tidal observations continued day and night during the whole time the party remained there.

This survey was conducted under circumstances of more than ordinary difficulty; *firstly*, from its being the hottest period of the year; *secondly*, owing to the bad state of health of both officers and men, the Canara fever being rife, not more than half the strength of the party was at any one time available; *thirdly*, cooly labour was difficult to procure at any price, even double wages at times failing to secure a sufficient number of labourers to cut away the thick thorny jungle—a work which was necessary to open out for surveying purposes. It is, however, due to the party, both officers and men, to say that under all difficulties they worked with a will and spared themselves no labour. (*See remarks on Marmagao in Appendix I*).

RECESS.

Lieutenant Petley's party returned to Bombay on 11th May for the recess. But, as the Canara jungle fever still lingered amongst all, and the damp climate of Bombay in the rains aggravated the sickness, the party were permitted to proceed to Poona on 1st July. This move proved advantageous in every way; in the first place, the health of the officers improved rapidly, and secondly, drafting operations benefited in the drier atmosphere of the Deccan. Both at Ratnagiri and Bombay all drawing paper was so saturated with moisture as to be nearly useless, and only by placing charcoal fires under the tables could the paper be rendered in the least serviceable.

From the time of their return to Bombay in May, and till the end of September, all the officers were engaged in plotting the results of the season's work, and in making fair copies of the same, completing the registration and calculation of tidal observations, &c.

APPENDICES.

APPENDIX A.

General Report upon Indian Lights, after a preliminary inspection by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

IN the summary of my first General Report on Light-houses, dated 1st June, 1879, I proposed that a preliminary inspection of all Indian lights should be undertaken during the cold season of 1879-80, and a report furnished of the actual requirements of each light or port. This proposed inspection I have carried out, and would submit the following report:—

Kurrachee.

1. Commencing with Kurrachee, I need only say that the newly-erected first order dioptric revolving light is a model of perfection, and appears to be economically worked. This light is looked after by natives under the immediate superintendence of the Port Officer, thus avoiding the heavy expense of a European light-keeper.

2. It has been proposed by some nautical authorities, and the proposal seemed to chime in with the views of the Harbours Defence Committee, that the beautiful light at Kurrachee should be transferred to Cape Monze, which is 17 miles westward of the port, and that a mere harbour light should be erected on Manora Point. I have already expressed my total dissent from this proposition, and would again protest most emphatically against what I consider a very unwise measure.

3. Kurrachee harbour lies at the bottom of the bay, formed between the mouths of the Indus and Cape Monze—a veritable *cul-de-sac* where the brilliant revolving light of Kurrachee stands to guide vessels in from a distance of 25 miles. Were a mere harbour light placed there (not visible more than 10 miles generally and less in hazy weather), unless another first class screw-pile light-house were erected off the mouths of the Indus, the difficulty of making Kurrachee would be greatly and dangerously increased.

4. Time failed me this season to get as far as Kurrachee, but I inspected the new light shortly after its erection; however, I wish to proceed there again to witness the positions in which the Defence Committee have placed the batteries and to select a site for a new light-house which shall be on equally elevated ground and less liable to concussion from the firing of the guns, if it be considered essential that the artillerymen should maintain practice with those heavy guns. The general question, moreover, of the complete lightage of this port needs to be thoroughly gone into, but can only be decided on when it is known where the harbour works will terminate.

Cutch Mandvi.

5. At this port a new catadioptric fourth order fixed light has been maintained by His Highness the Rao for the last seven years, and is in tolerably good order and economically worked. Cocoanut oil is used now for this light; at first kerosine was adopted, but an explosion occurred through the ignorance of the light-keeper, whereby some of the upper prisms were cracked; these have not been repaired.

Bet or Bate.

6. On the highest and nearly the central part of Sainia Island, and outlying rock of Bet, there is a very good fourth order catadioptric light, but it is advisable that an all-round light of the same order should be substituted, whilst this one will do excellently for Dwarka Point. The fair channel into Bet, as well as the channels amongst the many reefs, require to have bright leading rays of light with red and green shades to mark the banks and reefs, on the sides of the channel. In a separate letter I shall point out what alterations and additions the Darbar of Baroda might usefully make to the lights at Bet, Dwarka, and Diu Head.

Tuna and Roji.

7. At the head of the gulf of Cutch two little port lights have been set up one by the the Rao of Cutch on the north side (Tuna), and another by the Jam of Nowanagar on the south side (Roji). These are useful for the native craft, and suffice for the head of the gulf, which is only navigated in moderate weather.

Salaya or Seraia.

8. But a light is much wanted at the entrance of Salaya Creek on Chanka Reef, which is the most prominent danger on the south side of the gulf, hereabouts only 15 miles broad. Such a light as a cross light to Cutch Mandvi would greatly facilitate the navigation of the gulf. His Highness the Jam of Nowanagar should be invited to erect a stone light-house at the north-east extreme of Chanka reef, with a dioptric light of the fourth order. This, with the addition of a small port light up Salaya creek, would enable vessels of all sizes to utilise this excellent port of refuge.

Dwarka.

9. Next comes Dwarka light on that prominent headland which was pointed out 30 years ago by Commander Albany Grieve, one of the best surveyors of the late Indian Navy, as the site for a landfall light. The cliffs of Dwarka are about 50 feet high, and a small tower has been erected there, about 100 yards within the cliffs; however, only two small kerosine lamps have hitherto been exhibited there. As stated in paragraph 6, the present lantern at Sainia (Bet) island will do well for Dwarka Point if an all-round light be provided for Sainia. This will form the subject of a separate letter as mentioned above.

10. It is very essential that myself, or an officer of my department, should visit the spot when the new light arrives, to ensure that the arc of visibility be properly arranged. Both at Sainia and Porbandar, as well as Verâwal,— all these ports belonging to Native Chiefs,—I found that the proper arrangement of the arc of visibility had been neglected; and the light apparatus, not being fixed by the proper pin, was liable to be turned round by the hands of the light-keeper during the operation of trimming; and, as a consequence (notably in the case of Verâwal, a great portion of the light was allowed to show over the ancient temple of Somnath whilst the coast to the north was unlighted) the extent of sea over which the light was thrown varied at times. This may account for the occasional reports which are handed in by the commanders of coasting steamers, that such and such a light was not visible till within 5 miles distance.

Porbandar.

11. On a tower at the water gate of the town wall of Porbandar port, there is a catadioptric fourth order light which is ample for the requirements of the port, and is cheaply kept up. Small light dues are collected to the amount of Rs. 2½ on every ship or steamer anchoring here and 5 or 6 annas for every native boat. The native collector of customs has charge of the light.

Mangrol.

12. On the highest square house in the fort or walled town of Mangrol, and about 400 yards within the landing place, a small country lantern exhibits a poor light, but as a port light it suffices, and the fact of its not being visible far off prevents its being mistaken for the better lights of Porbandar and Verâwal which are on either side.

Verawal.

13. On the pier head which forms the north-west side of the boat harbour of Verâwal, there is a good fourth order catadioptric light, which (as previously stated in paragraph 10) on the occasion of my visit in November last, had not been properly fixed. Here light dues are levied to the extent of Rs. 2 for each steamer and Re. 1 for foreign country boats, whilst the boats belonging to the port are exempt from dues. This light is also cheaply and well kept, and it might also be mentioned to the credit of His Highness the Nawab of Junagarh, that he is endeavouring to improve the boat harbour of Verâwal at considerable outlay. The light-house which has been erected at the end of the pier is a well-built and solid structure.

Diu Head.

14. Here is the place to mention how important a situation for a landfall light is the little cape which mariners call Diu Head, but properly Modwa Point. I believe this small piece of land (lying to the westward of the Portuguese possession Diu Island) belongs to His Highness the Gaikwar of Baroda. I venture to suggest that as Modwa Bay affords excellent shelter to native craft from northerly and westerly winds, the Darbar of Baroda should be invited to erect a light-house on the cape in the interest of the shipping of Kattiawar and Guzerat. For the maintenance of this landfall light some small light dues should be charged, leviable at Kurrachee or Bombay. There cannot be a doubt that a revolving light of fourth order on Diu Head would redound greatly to the credit of the Gaikwar of Baroda.

Port of Diu.

15. The small port of Diu has not a large trade, but, for the benefit of coasting steamers calling there occasionally and native craft in general, I think the Portuguese Government at Goa might be invited to consider the advisability of erecting a small light at the flagstaff at Diu fort.

Jafarabad.

16. Eastward of Diu the next port is Jafarabad, where the Nawab of Janjira maintains a small port light which suffices to indicate the entrance to the creek, and is likewise a great benefit to all coasting craft.

Shial Bet.

17. Further eastward we come to the excellent little refuge harbour behind the island of Shial Bet, otherwise called Chanch or Pipalwao. The island of Shial Bet belongs to Jafarabad, so does the extreme west point of the harbour. The north-west shore belongs to the Nawab of Junagarh, whilst the northern and eastern coasts belong to the Thakur of Bhaunagar. By a tripartite arrangement between these three chiefs, this little snug harbour might be made an excellent refuge by night, as well as by day, by the erection of a light-house on Chanch West Cape (I believe the Thakur is already building a light-house there), supplemented near the little temple which belongs to Junagarh by a small bright light to lead through the entrance channel with red and green cuts on either side to guard the rocks. A bright ray from this light should also be shown to the eastward to guide vessels into the harbour through the east entrance.

Mowa.

18. On the terrace roofing of the light-keeper's residence situated on a prominent cliff near the entrance of Mowa creek, the Thakur has placed a very good little fourth order catoptric light, the up-keep of which amounts to about Rs. 70 per mensem, and is a valuable addition to the lightage of the south coast of Kattiawar.

Goapnath.

19. The south-east cape of Kattiawar near the old temple of Goapnath, having dangerous off-lying reefs, has been marked by the erection of a catadioptric light of the sixth order, which is visible 8 or 9 miles off, and is highly valued by all the coasting craft. No light dues are levied in respect to this and the Mowa light, the cost of maintenance being generously defrayed from the general revenues of the Bhaunagar State. I am of opinion that if a light be put up on Diu Head, it is reasonable to levy a small light toll upon steamers and all native craft trading between the Gulf of Cambay and the coast of Kattiawar and Cutch. The only question is, where the toll should be levied. The Commissioner of Bombay Salt Customs, who entertains revenue cruisers in the Gulf of Cambay, could easily manage to levy such fees as might be established by the Government of India. The European coast-guard inspectors (as they call themselves) in charge of these cruisers are bound to board every vessel which they meet, and ample opportunities are, therefore, afforded for ascertaining whether these vessels have paid the light dues.

Perim Island.

20. This island was formerly the rendezvous of Katty pirates who fortified the place. On the ruins of an old bastion, the Bombay Government have erected a good stone tower with a fourth order dioptric light, which, for an outlying light, is very economically maintained by the Salt Customs Department. This light-house, and that of the Oyster Rocks at Carwar and Vingorla Rocks light, are all places difficult of access in the south-west monsoon, and great credit must be given to the Salt Department for being able to relieve and supply these three light-houses at very little cost to the Government. I have already pointed out in my first General Report on Light-houses (see paragraph 10) the extravagant expenditure which has been allowed in the maintenance and relief of similar out-lying lights on the coast of Burma, and after my more recent inspection I am convinced that on the latter coast the outlay has been excessive and quite uncalled for. Perim light-house is the landfall light for Gogo and Bhaunagar, and, indeed, for all the ports in the Gulf of Cambay.

Gogo.

21. The light at Gogo consists merely of a large ship's lantern on a post near the flagstaff, and is placed there by the postal authorities to guide the post boats into this little port, when they come over from Bhagwadandi with the mails from Surat. A more modern lantern would furnish a better light at less monthly cost and should be supplied.

Bhaunagar.

22. As I have already reported (see paragraph 10 of letter No. 84 (Surveys), dated the 24th December, 1878), a marked improvement has taken place in the channel leading to Bhaunagar creek. About eight years ago the Thakur placed a fourth order catoptric light on a wooden structure at the mouth of the creek. This light has answered very well, but I think that, as the trade of Bhaunagar developes itself, a rather better light might advantageously be substituted, and this should show red and green cuts to mark the sides of the fair channel. I am in hopes that the commerce of Bhaunagar will greatly increase when the railway connects this port with the Bombay and Baroda line. Already His Highness the Thakur has built stone docks for the country craft where they can discharge their cargoes under cranes. Great credit is due to His Highness for constructing these works, and for the erection of the four good lights round his coast; he has also placed a small light here to guide vessels to the mouth of the creek which leads into the dock, and I should greatly rejoice if His Highness the Gaikwar, with the other chiefs of Kattiawar, and the authorities at Diu, Damaun, and Janjira, would follow so good an example.

Khunbandar.

23. The shoals in the Gulf of Cambay have undergone material changes and accumulation, so that a thorough re-examination must precede any determination of the points where lights should be placed for the country craft which carry away the Dholera cotton. The light of Khunbandar, though a poor one, may suffice for the present. On account of the erosion of the banks by the current, the position of the light has required to be very materially changed during the last ten years.

Deojugan or Tankaria.

24. On the Guzerat side of the gulf, Cambay town has no light, nor does one appear to be called for, because the railway has superseded the sea-borne traffic. Tankaria is a town of some importance inside the Dhardar river, at the mouth of which a common lantern with six oil burners is hoisted on a mast. This light, though very inferior in brilliancy, burns twice as much oil as the good lights at Perim island and the Taptee river. A light such as that at Goapnath Point on a masonry tower should be erected at Deojugan.

Nerbudda.

25. The mouth of the Gulf of Cambay is very narrow between Perim island and Broach Point, and it would materially assist commercial navigation if a small light were placed near the mouth of the Nerbudda river, which should be a leading light into the river over the bar, having red and green cuts on either side to mark the banks. To this subject I shall again revert in a separate communication concerning Jageshwar.

Bhagwadandi.

26. Several native tindals and ship-owners memorialised me on the subject of having a better light at Bhagwadandi, the present one being only a common country lantern with one burner, set up by the postal authorities, who run the dâk boat between Surat and Gogo. A better light, either at the present site or at the village of Dandi, would be really valuable. I should prefer two lights vertical on a mast 50 feet high, or one of the tall Palmyra trees of Dandi might be utilised for the purpose. The lanterns should be similar to those at Vingorla Point, placed 15 feet apart, sliding up and down between two iron rods. A light of this nature would effectually prevent

native craft from approaching too near to the Bhogwa Sands, and it would cost only about Rs. 1,500.

Tapti.

27. On a sandhill 40 feet above high-water mark, near Vaux's tomb, indicating the entrance to the Surat river, stands the tower of Tapti light, a fourth order catadioptric light which is very efficient. There should, in my opinion, be a small sixth order signal light, at Domus village, on the eastern shore of the Tapti, a light being required there as a cross bearing from the anchorage.

Bulsar.

28. There is only at present one light between Surat and Bombay,—namely, that of Bulsár, which is a very poor light, and only useful for the country boats which can run into Bulsár creek; a large vessel could not anchor within 9 miles of Bulsár without grounding at low water, and from that distance she could not see the present light, but it seems to suffice for the coasting craft.

Danu.

29. The dangerous reefs off Dánu and Tarapur ought to be guarded by the light visible at least 12 miles. This is the most dangerous point between Bombay and Surat, as the foul ground here extends fully 6 miles off. A fourth order catadioptric light on a column 50 feet high is required for Dánu Point. Its position should be determined by the Department of Marine Surveys after actual inspection of the spot, because there is a little sheltered harbour within the Dánu reef, and the light might be made so as to lead clear into the port.

Bombay.

30. The approaches to Bombay Harbour are well lighted, but the only impediment to safe navigation is the fishing stakes. Rules ought to be laid down that they should only be allowed to stand on certain lines of bearing from the Prongs light, so that the clear lanes for steamers might be known. Prongs light and Kennery light-house are all that could be desired, and the expenditure upon them is regulated by the Port Trust Engineer. A small light-house on the sunk rock has been sanctioned by the Bombay Government, and when completed its light will do away with the necessity of the inner and probably the outer light-ship.

Rajpuri.

31. Southward of Bombay there is no established light for the distance of 100 miles, but the Habshi of Janjira should be invited to place one on his fort, which would lead a vessel inward. A red ray might be thrown over the Whale rock.

Bankot.

32. As this is the port by which communication with Mahableshwar is kept up, I should recommend two small lights, one 20 feet higher than the other, and the two lights in line leading over the bar. Chance Brothers' port lights costing less than £50 each would suffice.

Dabhol (Anjanval).

33. At this port, during the fine season, the owners of the coasting steamers exhibit a light from the Dabhol headland to guide their vessels. I believe this light is only exhibited at the times when their vessels are expected, but it should be a permanent light* during the fine season and the Bombay Government should take it in hand.

Ratnagiri.

34. As a port light being placed on a hill upwards of 300 feet high, this light is very unsuitable. I think a good landfall light might be placed on this headland. A bright light of the fourth order would suit well. The present light is red, and its rays are so condensed by the red glass that it is scarcely visible 7 miles in the finest weather. The extreme loftiness of Ratnagiri headland effectually prevents such a light from being mistaken for any other adjacent light. I would have two small lanterns placed vertically 10 feet apart near the custom house of Ratnagiri, which lights would give a cross bearing to the anchorage. During the monsoon time, when this port is closed and the mails and passengers are landed at Kalbadevi Bay, the same lights might be shown there.

Rajapur.

35. On the headland between Rajapur and Viziadurg rivers a very good little light is shown during the fine season. It is intended for a guide to coasting steamers and country craft making for either Rajapur bay or Viziadurg. But if ever the latter fine port is to be made easily accessible as a harbour of refuge, a light should be exhibited from the N. E. bastion of the fort.

Malwan.

36. The little green and red lights, now shown at Malwan during the fine season, seem to answer pretty well for small coasting steamers, and the buoys, as well as the lights, are looked after by the Salt and Customs Department, whose cruisers have ample opportunities of seeing to the wants of the different ports.

Vingorla Rocks.

37. Now we come to one of the outlying light-houses of the Bombay coast under the control of the Salt Department. A boat and crew are kept here for maintenance and relief of the light-house during 9 months of the year, care being taken that a full supply of provisions for the monsoon months is stored on the rock; the up-keep of this boat is less than Rs. 700 per annum—a sum which is in striking contrast with the Burma coast charges for the Oyster reef, Savage Island, Double Island, Eastern Grove, &c. Better arrangements for landing men and stores are needed at these Vingorla Rocks, as at Alguada Reef, the Cocos and Double Island in the Bay of Bengal.

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* The Commissioner of Salt Customs has just notified that a new fifth order dioptric light will be exhibited in October next on the south headland of Anjanval River.

Vingorla Point.

38. The two white lights on this headland, vertically placed 20 feet apart, are excellent; indeed, this is the kind of distinctive light which I wish to see introduced at several other places on the coast of India. Their up-keep is very trifling, and the original cost not much, whilst their brilliancy is so great as to render them visible actually farther than the single light on the Vingorla rocks.

Goa.

39. The next light is in Portuguese territory and forms an excellent landfall light, but supplementary lights will be needed for the new harbour of Marmagao. This subject will be fully reported on when the survey now in hand is completed.

Carwar.

40. This is another outlying light, built on the Oyster rocks and looked after by the Salt and Customs Department; the apparatus is kept in excellent order by a European light-keeper, and the cost is reasonable. No extra expenditure (as on the Burma coast) is incurred in maintaining and relieving this light-house, but (as I have formerly suggested) the Port Officer at Carwar should have a steam launch to communicate with these rocks during the south-west monsoon, as well as for boarding vessels which remain outside in want of a pilot.

Coompta.

41. The next light-house is at the important town of Coompta. But the light is of the most inferior order, although it uses four times as much oil as Ratnagiri, Perim, or Taptee. It has three country-made brass reflectors and is without chimneys. There is no proper ventilation; there is no lightning conductor on the tower; the cowl at the top will not revolve. I would recommend a 6th class light as at Goapnáth. The saving in oil by this change would pay for the new light in ten years.

Mangalore.

42. This finishes the Bombay lights. Now we enter upon the Madras coast. Mangalore has a very good catadioptric light of the 4th order, which is cleanly and economically kept. The light is better placed now for vessels anchoring off the mouth of the river than it was when the river mouth was further south. A little light placed on the sandy beach would be useful, in line with the upper light, to lead vessels over the bar, and the position of the lower light could be changed as the bar changed. Such a supplementary light, merely a port light of 6th order, would be a great boon to coasting vessels during the fine season.

Cannanore.

43. There is now a small 6th order Chance's port light with red glasses at Cannanore. It is at the masthead of the fort flagstaff in a very awkward position. The mast is decaying and the shrouds are very loose and badly set up. The Master Attendant, Madras, informs me that he proposes to build a laterite column for this light with steps, so that the men can approach to trim it with less risk in windy weather than they have now to undergo in getting up the mast. With the height of the fort the proposed column will give the light an elevation of 60 or 70 feet, and this will be ample. As at present arranged, it is impossible in bad weather to trim the lamp without the wind blowing it out.

Telicherry.

44. The flagstaff at Telicherry is dreadfully rotten, and a new one has been brought there, but the same objections apply to this method of shewing the light as at Cannanore, and the same remedy has been proposed by the Madras Marine Authorities. This has my entire approval. It will be remembered that Telicherry, Cannanore, Mangalore, and Coompta are ports which are closed during the south-west monsoon.

Calicut.

45. I have already reported the badness of the Calicut light. It was originally stated to be a first class country-made, but this would appear to consist of three brass reflectors and three wicks, and these so placed that only one reflector could be seen at a time. The consumption of oil is about one gallon per night, which is five times as much as is consumed by the light at Telicherry, and the brilliancy of each is about equal: however, a new fourth order catadioptric light has been sanctioned by the Madras Government, and will, I trust, soon be exhibited after next rainy season.

Beypore.

46. There ought to be some light at Beypore to indicate the anchorage on a dark night. Two vertical lights hoisted at the flagstaff, in lanterns such as those used by the Bengal pilot brigs, would suffice to point out the position of the railway station, and these two lights could certainly be seen four miles. As Beypore is a terminus of a railway, I think the Railway Company might well afford to put two lights up to lessen the dangers of an approach to this port.

Cochin.

47. There is a very good light-house on a small mound which formed a bastion of the old fort of Cochin. The light is catadioptric of the fourth order and economically kept. I noticed, however, that the lightning conductor goes up inside the building and does not project at the top. It was probably supplied too short, but the omission ought to be rectified.

Narakel.

48. During the south-west monsoon the port of Cochin is closed and all ships anchor off Narakel about five miles further north; there a small fixed white light elevated about 80 feet above the sea is exhibited from a flagstaff and proves most useful as a guide to shipping.

Quilon.

49. Troops are sometimes landed or embarked at this port, besides which the provincial trade generally, and particularly that in coffee from the Travancore hills, is increasing so much as to warrant the

exhibition of a small light at Quilon* during the fine season, say from 1st September till the end of May. The lantern should be similar to, but better than, that at Telicherry. One of the Chance Brothers' port or signal lights of fifth order would suit well with bent glass slides in front of the optical glass for coloured lights (red to left and green to right); whilst the bright light between them would stream outward through the fair channel which leads into the anchorage. The cost of such a light is only about Rs. 700, and the entire fitting up thereof about Rs. 1,000. It should slide up two iron rods from the cross-trees of the new mast erected in front of the Scottish company's warehouse.

Alipee (Alleppey).

50. At Alipee on the sea coast of Travancore one of the best of our Indian lights is exhibited. It is revolving and has three faces with three lamps each, or a total of nine lamps, somewhat like those at the Alguada reef, but the lamps are very costly to maintain; they burn so much oil and require so many men to trim them. Moreover, the monsoon anchorage of Alipee is nine miles further south, abreast of Porcaud, where the coasting steamers can only pick up the anchorage in bad weather by the merest chance.

Porcaud.

51. There ought to be a small fixed light at Porcaud; a sixth order signal light like that of Telicherry would suffice, exhibited on a little platform built of laterite. Such a light would be a great boon to shipping, and its erection might be pressed on the Government of Travancore.

Muttam.

52. Some time ago it was resolved by the Madras Government to put a first order dioptric light at Muttam Point. Captain Dalrymple, the late Master Attendant of Madras, having persuaded the Government to place a revolving 1st order light on Cape Comorin, both were ordered and procured from England, but neither has been set up yet. That for Cape Comorin was transferred to Kurrachee, whilst that for Muttam is still lying in cases at Tuticorin; it is most fortunate this expensive apparatus is at Tuticorin, for there is no *drier* spot in the south of India. The design for the light-house and keepers' quarters at Muttam appears to be either not arranged or not sanctioned. I have visited the site chosen, and there is nothing to hinder the erection of a tower about 40 feet high on ground which is 80 feet above the sea. As the cause of delay in putting up the new building, I am given to understand that the Public Works Engineers want to build a lofty light-house, the cost of which would absorb all the money allowed and leave none for the light-keeper's dwelling, which *must* be built. It is a great pity such delay is allowed in the erection of this light-house and the exhibition of the first order light. The light at present exhibited is of the same poor construction as those of Calicut and Coompta,—namely, three brass reflectors and their wicks without any chimneys. Such an apparatus cannot be expected to give a good light. I have found out on this last inspection that the coasting country craft take shelter under the lee of Cape Comorin when the north-east winds are strong. A light of the first order as proposed at Muttam would send its rays as far as Comorin and be a great boon.

Comorin.

53. A small light on this cape is required to complete the chain of lights round this coast. This light on Cape Comorin would be a landfall light, and vessels trading between the Malabar coast and Ceylon should be charged light dues.

Manapaud.

54. The safe navigation of the gulf of Manar requires that a small light be erected on Manapaud Point. As this cape has considerable elevation a tall light-house is not needed, and to make it thoroughly distinct from Comorin on one side and Tuticorin on the other, I should advise two lights vertically placed 20 feet apart, on a mast as at Vingorla Point in the Bombay presidency. The original cost would not be more than about Rs. 1,000, or say, with light-keeper's dwelling, Rs. 2,000, and the up-keep will be very trifling—about Rs. 60 per mensem. Manapaud should be one of the imperial or provincial landfall lights on which a toll is levied. There cannot be a doubt that the multiplication and improvement of lights along the Indian coast must tend to diminish the amount of insurance on vessels.

Tuticorin.

55. The fixed fourth order dioptric light on Hare Island off Tuticorin harbour is a very good light and economically kept up. The additional light above recommended would be a great benefit to the port of Tuticorin, which being the terminus of the South Indian Railway, ought to have its approaches better lighted.

Paumben Pass.

56. The recent surveys executed by the Marine Survey Department demonstrate pretty clearly the difficulties that will have to be encountered in the formation of a deep ship canal in the vicinity of the Paumben pass. I have stated in a previous report on some of the harbours on the Madras presidency that "we may dismiss to the next century all idea of a grand Paumben canal." But I have pointed out that the present pass, if deepened 4 or 5 feet, would be much to the advantage of the coasting trade. The present light at Paumben is a good light and may suffice for the present, but a small leading light on one of the coral islands, southward of the pass might ultimately be added.

Calimere.

57. It was some time ago proposed that a revolving dioptric light of the 4th order be displayed on Calimere point to enable vessels to steer clear of the shoals which lie across the entrance of Palk's bay.

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* I am happy to say that since my visit to Quilon, the Commercial Agent of the Travancore Government has written to ask what kind of light should be put up at this port.

Either such a light should be placed here, or two small lights vertically placed which show so well as those at Vingorla point. The cost will be much the same as those recommended for Manapaud Point.

58. This report on Indian light-houses should not include any of those on the coast of Ceylon, but I feel bound to reiterate the suggestions made in paragraph 43 of my first general report on light-houses :—

Kangasenthoray.

> "I think the Colonial Government might be invited to consider the advisability of putting up a 4th order light at Kangasenthoray, which is the landing-place for Jafnapatam during the south-west monsoon. Coasting steamers carrying goods from Madras to Jafnapatam all the year round would greatly benefit by small lights at Calimere and Kangasenthoray, as the intervening shoals are a real source of danger."

Negapatam.

59. The 4th order catadioptric light of Negapatam is quite sufficient to mark that roadstead which has a railway terminus; the coast hereabouts is very shoal and the Negapatam creek is a very insignificant affair.

Karikal.

60. The French authorities have a small port-light hoisted on the flagstaff at Karikal, but being only ten miles from Negapatam it would be more advisable to hoist two small lanterns here to distinguish these two places. It must be remembered that I am now considering how to improve the system of Indian lights around the coast. A mutual understanding between the British and French Governments would settle what is best for the coast navigation generally.

Coleroon.

61. It has been proposed to fix a country lantern of the 3rd class to mark the Coleroon shoals. But I must repeat what I said in a former report—

> "I trust all these country-made old-fashioned reflectors will be discarded."

Moreover, I should like to make an examination of these Coleroon shoals before deciding upon the nature of light to be placed up there.

Pondicherry.

62. The light at the French port of Pondicherry is well spoken of by navigators, and is quite sufficient for this part of the coast. A toll of 15 centimes per ton is demanded of all ships anchoring at Pondicherry.

Madras.

63. The catoptric light of Madras shows a very brilliant light, but having 15 lamps it requires many men to attend to it. This, however, is not of so much consequence at Madras, where the labour is cheap. When the harbour is completed, distinctive lights will be needed at each pier head. Now, two red lights (vertical) are shown at the outer end of the north groyne of the harbour works, and will continue to be exhibited as the works progress seaward.

Pulicat.

64. Rather more than twenty years ago, a large sailing ship having grounded on the Pulicat shoal, it was deemed essential to safe navigation to place a small light on the shore abreast of this shoal. The question was referred to me by the Government of Madras and the erection of a light at Pulicat was suggested; but I pointed out that, if Madras light was white, that of Pulicat should be red. This was merely to prevent one from being mistaken for the other, as I was not then aware that Madras light was flashing. Having lately, within the last five years, occasionally passed the red light of Pulicat without seeing it distinctly, I am now of opinion that it should be a fixed white light. At the same time the Armegon light should be slightly changed.

Armegon.

65. This is a very good 4th order catadioptric light to warn vessels off the Armegon shoal, the shoalest part of which (10 feet) lies six miles off shore. If my proposal to give Pulicat a white light be adopted, I would merely alter the character of Armegon light by placing two strips of red glass, a little apart, on the outer glass panes of the lantern, the effect of which would be that ships sailing by would recognise this light. For the benefit of small coasting vessels, I would have a red shade over the northern tip of the Armegon shoal, so that they could run behind it with safety towards the village of Moonapolium when they saw the bright light. These changes, however, could not well be made without my proceeding to the spot in a small vessel at a calm season of the year.

Kottapatam.

66. Northward of Armegon light-house there is no light for the great distance of 140 miles. The town of Kottapatam seems rising into importance, and it would be a great boon to place a light somewhere here. Two small lights, vertically placed, as recommended for Manapaud point, would answer well.

Point Divi.

67. For the last ten years a 4th order dioptric light has been exhibited from Point Divi, principally as a landfall light for Masulipatam, but of great service to all ports between it and Armegon. Not having been able to reach this light-house before the southerly winds set in, I must reserve any further remarks, in hope that during the next fine season I may be able to inspect this light-house and the coast between it and Madras.

Masulipatam.

68. A dioptric 6th order light is now exhibited on the flagstaff of this port, and together with the Point Divi light meets the local requirements. Some years hence, when we are able to make a proper survey of this coast, the question of opening up fresh ports and improving the lights should be

thoroughly gone into. Narsapur point is so prominent and the river is so good as to deserve a small light for the benefit of the coasting trade.

Coringa.

69. The light at this place is of the obsolete country pattern, with brass reflectors. There are 9 lights and reflectors arranged all round the compass in an unnecessary manner. Cocoanut oil is used, and there are no glass chimneys. It is well known that the light-house being too far within the sea margin, and having such poor lamps, is generally complained of by mariners. Such changes are now, however, taking place at the mouth of the Godavery as to call for a re-examination of the approaches to Cocanada, and then it will be time to consider what had best be done, either imperially or provincially, for the better lighting of this part of the coast.

70. Certainly something ought to be done in view of showing a better light at the present Hope Island light-house, either by a better arrangement of the present lamps or by substituting a 3rd class dioptric light. The merchants at Cocanada complain that the port dues of that place are partly spent on the up-keep of the poor light at Hope Island, which is outside of their port, and of little benefit to them, whilst improvements to the port of Cocanada are limited owing to the double expenditure on the lights at Hope Island and Vakalapudi.

71. Looking to the general question of lighting the coast of the Bay of Bengal, a glance at the chart will show that the vicinity of Hope Island light (somewhere southward of Point Godavery) should properly have a good landfall light. This should be an Imperial light and maintained by the levy of light dues, similarly with the Alguada reef on the coast of Burma. The question of these imperial landfall lights shall, however, form the subject of a separate communication.

Vakalapudi Cocanada).

72. The recently erected small revolving light at Vakalapudi to guide vessels into Cocanada harbour is an unmistakeable guide to vessels coming from the north; but until Hope Island shows a better light, the safe approach from the south must be very much dependent on the lead. The coasting steamers generally prudently wait till day-break before entering Cocanada harbour. Several sailing vessels have lately taken the ground whilst attempting to run in, but these accidents are principally owing to the ignorance of their commanders and through not having proper charts.

Vizagapatam.

73. Since the light which was exhibited on the Dolphin's Head at Vizagapatam was destroyed in the cyclone of October 1876, the light has not been replaced. Navigators, in general, did not think this light of much importance because it was no guide to them for entering Vizagapatam roads. I am of opinion that the most useful light for Vizagapatam would be two lights vertically 15 feet apart hoisted on the flagstaff. These would be seen 7 miles off on a N.-W. bearing as a vessel approached from the southward; she would keep clear of the Dolphin's Head and steer in when the flagstaff bore W.-N.-W., and would anchor in any convenient depth. The cost of two good lights as at Vingorla point would not exceed Rs. 1,500, whilst the up-keep, being under the supervision of the Port Officer, would not be more than Rs. 500 per annum. There was great difficulty in maintaining the old light on Dolphin's Head, the ascent of that hill being very steep and difficult by night; there was, therefore, no thorough supervision of the old light.

Bimlipatam.

74. If two lights, vertically placed, were exhibited at Vizagapatam, a small single light might well be shown at some house at Bimlipatam as a guide to this port, which has a considerable European as well as coasting trade. The up-keep of such a light under proper superintendence would not exceed Rs. 30 per month.

Santipilly.

75. In a communication, dated the 2nd October 1877, addressed to the Government of Madras, I reported upon this light and suggested that a dioptric *fixed* light of second order, like that placed on the Oyster Reef at Akyab, but throwing a *red* sector over the Santipilly Reef, be substituted for the present light. The Port Officer of Madras, to whom the matter was referred, agreed with my proposal and stated that the present fourth order dioptric light could be utilised to replace the one formerly exhibited at Dolphin's Head. The alteration was sanctioned by the Government of Madras, but has not yet been carried out. Chance Brothers' totally refracting mirrors should be placed on the landward side to intensify the light seaward.

Calingapatam.

76. Owing to the local conditions of the weather at Calingapatam, and as the trade there is small, I would not recommend any better light than the existing one for this prominent point. A low light would be often obscured by a low-lying mist and sand haze, whilst a lofty light at certain seasons of the year is concealed in the horizontal bands of mist arising from the swamps; whilst the base of the column is frequently visible. Under these circumstances, the commanders of most coasting steamers make the port by daylight, and by careful attention to the lead avoid the point at night time when the light may be obscured.

Gopalpore.

77. The low-lying haze or mist which prevails at Calingapatam, during the prevalence of southerly winds, extends along the whole coast northward to False Point. The present small light exhibited on the flagstaff at Gopalpore is sufficient for a port light, but it sometimes comes under the influence of the mist. A careful attention to the lead will keep a vessel a mile or two off this coast, and at that distance the surf to windward will be heard during rough weather. This light being under the immediate supervision of the Port Officer is very cheaply maintained.

Pooree.

78. Since January 1879 a port light has been exhibited from Pooree, visible 9 or 10 miles. The light is obtained from six oil-lamps ranged round a hexagonal reflector; but two lamps on the landward side, which were quite unnecessary and only increased the consumption of oil, were extinguished after the visit of myself and Lieutenant Stiffe in October 1879. As a port light this is quite sufficient.

False Point.

79. The recent substitution of a first order dioptric apparatus at False Point in lieu of the old argand lamps of an obsolete pattern (which had been used for several years, without chimneys and were consequently doubly inefficient) is already most favourably reported on by navigators. This brilliant light can now be seen 20 miles off; but, of course, as at Calingapatam and Hope Island, the low-lying mists from the adjoining swampy ground are liable to rise at times to the level of the light and would obscure the best of lights. Of course the charge of this new apparatus involves constant attention and great care.

80. Some of the appliances which have been supplied to similar lights on the coast of Burma have not been yet furnished to False Point. Storm panes of plate glass, and what is called a Liverpool lamp, are absolutely needed. This latter light should be of a pattern supplied by Chance Brothers, burning three concentric wicks and calculated to keep alight without trimming for about an hour. It is required in the event of anything happening to the main light.

81. The storm-panes of glass are arranged with nuts and screws so as to be rapidly put up in the event of one of the regular panes being broken. I would advise that the existing glass panes, occupying one-fourth of the lantern on the landward side, should be removed, and their places filled up by shutters of wood or copper; that the Public Works Department at Cuttack or Calcutta should fit gun-metal frames with nuts and screws to these panes as soon as possible, that provision may be made against any accident to the lantern at False Point.

Reddie Head.

82. In a former report on False Point, I called attention to the want of a light on Reddie Head. This was actually being prepared by the Government of Bengal when Captain Bullock, who has great interest in False Point Harbour, advised His Honor the Lieutenant-Governor that such a light was not needed. The recent grounding of the *Chinsura* (on board which vessel I was at the time a passenger) off Hookeytollah has convinced me of the importance of a light on Reddie Head, which point is utterly indistinguishable at night. It now appears that several coasting steamers have, in the early morning, got into shoal water off Dowdeswell Island whilst trying to find False Point Harbour; but through careful attention to the lead, they have hitherto escaped grounding. I submit that two lights vertically placed at Reddie Head would prove a great boon to navigators, and their up-keep would only be about Rs. 60 per mensem, which the port could well afford, as the False Point light-house is maintained by the port of Calcutta.

Dhumra.

83. With two lights (vertically 15 feet apart) at Reddie Head, a single fourth order fixed light might be exhibited on Shortts' Island at the mouth of the Dhumra, on a brick or stone column about 50 feet high. Such a light could be seen 11 miles, and would warn vessels off the Palmyras shoals. The trade of Chandballi and Balasore would be greatly benefited by a light on Shortts' Island; and this Dhumra light might prove a great benefit to sailing vessels approaching the Hooghly.

Cowcolly.

84. This light, which has been exhibited from an early date in this century, is of little use now, being too weak and too far away from Saugor roads. I believe the Port Officer at Calcutta has recommended that it should be extinguished. Half a century ago it was useful to vessels which entered the Hooghly along the Kedjeree shore. In the year 1844, when I was in the Indian Navy steam frigate *Auckland*, we anchored off Cowcolly light, but that western channel is not now used,—indeed it is unknown ground, not having been surveyed for many years. That western channel may yet again become the highway for ships, and then the improvement of Cowcolly light would be taken into consideration.

Floating light-vessels of River Hooghly.

85. During the south-west monsoon there are no less than six light-ships guarding the approaches of the Hooghly. These vessels and their light apparatus have been much improved of late years and the lights they exhibit are very good. The great drawback is that all the lights are similar.

86. Lieutenant Stiffe, the Port Officer, has just recommended that the eastern channel light should be made revolving. I quite approve of this proposal and of another one, by the same officer, that the Mutlah light and the Ridge light should be brought nearer to the Eastern channel light. These proposals seem to meet with approval by most of the senior pilots and several commanders of sea-going steamers. The recent improvement of False Point light renders the approach to that point much less hazardous than formerly; and the Pilot's Ridge itself, that remarkable bank of soundings extending from False Point to the north-east, will indicate the whereabouts of his ship to the careful mariner who takes the trouble to sound.

87. The many wrecks which have of late years occurred round the coasts of India in spite of the multiplication and improvement of lights, have been owing to the neglect of the lead; the increased number of lights seems only to make navigators less careful. Not only are lights multiplied, but the charts of our coast are much improved of late years, so that there is little excuse for vessels running into danger without warning.

88. The burning of blue lights to distinguish the different light-ships is now so systematised that one vessel ought not to be mistaken for another; but the fact remains that frequently partial, if not entire, eclipses of the blue light have been occasioned, when the ship is riding to the ebb and the blue light is burnt on the forecastle at the same elevation as the line of all the ship's awnings and behind the quarter-boats. It is of much importance that an arrangement should be made to prevent these unsatisfactory occultations of the blue lights. It can easily be done by fixing a sort of gallery above the boat's davits on each quarter, so that the light may be burned above the boat on the lee side, and at a considerably higher elevation than at present, when the ship is riding with her stern seaward. These ships are well manned and officered, so that attention could be given to this point. It should be impressed on the notice of the commanders of these light-ships that the primary object of burning the blue light is that it may be seen seaward, as far as possible.

Saugor light-house.

89. Many pilots profess to see little utility in the Saugor light, but it must be useful to indicate when their ships are high enough in the Saugor Roads for anchoring. This light, therefore, must be maintained, although Cowcolly light might be extinguished. A more modern apparatus would consume less oil and render the up-keep less expensive.

90. It is very probable that Captain Baird, R.E., the Superintendent of Tidal and Levelling operations, will soon erect a self-registering tide gauge on Saugor Island. If so, the time would be opportune to consider whether the expenditure at Saugor in the maintenance of the light might not be considerably diminished. Saugor is of the greatest importance as a telegraph station, and if the rise of tide could be signalled there, the benefit to out-going ships would be very great.

91. Between the Mutlah light-ship and Chittagong, a distance of nearly 200 miles, there is not a single light or beacon of any sort. The day may not be far distant when the opening up of the Sunderbuns to external trade and the necessity of some lights may be taken into consideration. At present the extreme danger of appoaching the banks in the night, especially near the mouths of the Ganges and the Bhramapootra, suffices to warn vessels off this treacherous coast. Numerous off-lying banks have been formed since the Sunderbuns were surveyed nearly 40 years ago.

Sundeep.

92. A traffic by small steamers, between the ports of Dacca and Chittagong, and through the Sundeep channel, has lately sprung up, and I think that a light at the south extreme of Sundeep, or on the mainland to the eastward of it, might greatly benefit these steamers as well as the sailing craft which navigate the Megna. My attention, however, has not been called to the question of putting up a light, yet I must propose a light for Sundeep channel, when considering the requirements of the whole coast of India.

Chittagong.

93. Since the Norman Point lights were moved further southward I have heard fewer complaints about the lighting of this coast, but there is no doubt that the lights marking the approaches to Chittagong are deficient; however, as I have previously reported to Government, I would postpone the consideration of placing superior lights until the coast and its off-lying banks have been thoroughly surveyed.

Kootubdea.

94. The dangerous north and south sands are outside the range of this light, but coasting steamers and sailing vessels find their way between the two, trusting to their soundings. I have already reported on the Kootubdea light, having been sent there specially in 1876 to examine it. The aparatus is of an obsolete pattern and consumes plenty of oil. But the most important question with regard to this light is whether the structure will long stand the ravages of the sea. Time failed me to go to Kootubdea this season, but I should like to proceed there again when the fine season opens. The light-house was visited by Lieutenant Stiffe, the Port Officer of Calcutta, at the beginning of this year, and I believe he was satisfied of its stability, but recommends a better light.

95. The south sands are a danger that requires to be marked in some way, and perhaps the recent proposal of Lieutenant Stiffe, to place there an automatic whistling buoy, might well be adopted. Such buoys require a rough sea and deep water, and here there is plenty alongside the sands. This is a very good situation whereat to make the experiment of an automatic buoy. Steamers pass the spot about twice weekly, and their officers could report whether the whistle was heard favourably.

Naaf River.

96. The Naaf River is the boundary between Chittagong and Burma. Should the inhabitants of the latter country become more numerous, a considerable traffic in rice may be developed at the Naaf. I so far examined the mouth of the Naaf River in February last as to satisfy myself that nothing but a close survey would indicate the fair channels and the positions for the buoys. St. Martin's Island well shelters the mouth of the river, and affords anchorage under its lee during westerly winds. A small light would greatly benefit this place, but the locality for it could only be ascertained after the survey.

Oyster Reef.

97. This is the northernmost light on the coast of Burma and has only been exhibited for four years; the light is very good and an immense advantage to the port of Akyab. The screw-pile structure appears very light, and the diagonal iron braces require yearly the attention of an engineer. As I have already reported to the Government of India, the appliances for ascending the light-house from a boat are not sufficient to insure safety in stormy weather; but it this light-house

were put under the care of the Port Officer at Akyab, he would make better arrangements for landing men and stores here.

98. Mr. Shopland, the present Port Officer, has suggested that a life-boat should be maintained for relieving this light-house. This boat might easily be towed out by a steam tug; or in the absence of such assistance, the life-boat might be taken through the creeks to the Myou River, which lies due north of the Oyster Reef light; from that river, watching an opportunity, the boat might easily sail out with a westerly wind and weatherly tide, and so reach the light-house conveniently. As pointed out in another report on the best method of relieving and supplying the off-lying light-houses, it should be borne in mind that a row boat must always be the medium of communication with this screw pile structure, and a good life-boat would be the safest and most convenient for the purpose.

Savage Island.

99. This light-house, solely in charge of natives, is in very good order. The light is a 3rd order dioptric revolving. Savage Island being right within the entrance of Akyab harbour presents no difficulties whatever in the matter of relief and supply, or, indeed, of inspection; and the Port Officer of Akyab should have charge of this place. Seeing that it lies inside Akyab River entrance, the fact of its having been relieved, supplied, and inspected from Rangoon, has caused a most unreasonable expenditure to be set down against this light, as pointed out in paragraph 29 of my preliminary report on light-houses. If placed under the Port Officer of Akyab, Savage light would not require six light-keepers to be always on the spot, as now.

Alguada.

100. This most excellent light-house, though very costly in its erection, has proved an immense boon to vessels, not only to those navigating the coast of Burma, but also to vessels which ply between Calcutta and Singapore. Alguada Reef light should always be an Imperial charge, and the port of Bassein should provide and maintain for itself one or two small port lights on Diamond and Hinghie Island. Such lights would greatly facilitate the entry and departure of vessels. In my previous report I mentioned how costly was the expenditure incurred in relieving, supplying and inspecting this light-house, and that the up-keep of the light is most expensive because the apparatus is complicated. But the substitution of a less costly apparatus involves great difficulty (as recently experienced at False Point) in maintaining a light during the period when the change is being effected; I would, therefore, let the Alguada light remain as it is.

101. But it is high time that an improved landing place be made on the south-eastern side of the reef, about 200 feet from the light-house. There is a basin in the middle of the reef, which fills with water at high tide, the water comes in a long depression in the reef where the rock (sandstone) consists of large, loose boulders, which could be easily broken up and thrown on either side, so as to form a nice channel inward form the sea to the basin. Mr. Sansoon, the light-house keeper, informed me that the Bassein pilots come under the lee of Alguada Reef, and even now, at high water, are able to land in the above basin in their small jolly boat which they carry in their large boat. Should the improvement which I have above sketched be carried out, landing for nine-tenths of the year would be very easy. Mr. Sansoon estimated that if 20 coolies were located on the rock for a month from the middle of January to the middle of February, under the supervision of the Public Works Department in Burma this little boat harbour could easily be constructed. The present landing place consists of a dock or basin amongst some rocks on the western side of the ridge on which the light-house stands; but with westerly wind there is considerable swell on. The boat has now to be moored under a crane, but the difficulty is to get into the dock in bad weather. This dock could still be made use of when easterly and south-east winds prevail.

102. The signalling arrangements at the Alguada light-house are now very bad; the Union Jack (hoisted to indicate that landing is possible) is a miserable little thing only 6 feet by 8 feet. They want a much larger cross-yard to be placed at a more favourable angle for reading the flags from Diamond Island; or, as the light-keepers wish, a flagstaff above the balcony. I think the last would be the best arrangement; the flags would then blow out clearly. The only other improvement I can think of would be a line of iron posts and a hand rail from the light-house to the boat harbour; towards high water in bad weather the waves break over the reef.

Krishna Shoal.

103. The two beacons (proposed by me) have been erected on the mainland abreast of Krishna Shoal, and now there will never be any difficulty in fixing the position of the light-ship. Although unable, for want of time, to make a thorough search for the old screw-pile structure, the soundings taken in the *Hugh Rose* convince me that a portion of the inner side of the shoal has been washed away. We found 4 fathoms at low water, 3 is marked on the chart.

Krishna Light-vessel.

104. The remark which I have made (see paragraph 88) about the Hooghly light-vessels applies even more forcibly to the light-ship *Colombo,* which is now at the Krishna Shoal. This vessel has not got a high forecastle like the *Star*; but she ought to be furnished with an elevated place, both at the bow and on her quarters, from which to burn the blue light. When she is riding ebb, a vessel 10 miles off in a south-westerly direction could not see her blue light. The lamps supplied to this vessel at Kidderpore Dockyard are very old and worn. Out of 8 of them the screws of 6 would not raise or lower the wicks; as a consequence, the lights have to be put out, one by one, whilst they are being trimmed, and the lantern requires to be frequently lowered and then kept down for a much longer time than it should be. The lamps being so bad, this light is not visible more than 7 or 8 miles off, and this is a good reason why a better arrangement should be made for burning the blue light.

China Bakeer.

105. Since the China Bakeer screw-pile structure was moved out to the edge of the shoal water, its utility to navigation has been greatly enhanced. The light is a very good one and kept up entirely by natives; but some of them have learned their duties at other light-houses under European superintendence. Greater facilities are required for climbing up the light-house in bad weather; there ought to be two or three ladders, so that, according to wind or tide, the relieving officer could make choice of one. This light-house was erected in 12 feet at low water, since then a sandbank has formed about a cable length outside of it, and this dries in one part at lowest spring tides. There is no harm in that sandbank forming there.

Eastern Grove.

106. Many navigators and pilots complain that the Eastern Grove light is of very little use, but if it was taken away they would complain more. I have already pointed out that it might be made a leading light for vessels leaving the river just after sundown. This could be effected by removing the vertical condensing prisms and placing strips of red and green glass on the south-west face of the lantern. By means of a catadioptric glass mirror (as at Double Island), placed at the north-west quadrant behind the light, say from W.-N.-W. to N.-N.-E., the back rays now unutilised could be collected and thrown out to the S.-S.-E. to intensify the light in that quarter. At present the light is cut off by the meridional line and not visible at all when bearing westward of north; whereas, if made brighter and visible when bearing as far as N.-N.-W., it would be a great benefit to vessels coming from Moulmein.

Amherst.

107. The entrance to Moulmein River is not sufficiently lighted. Double Island light is only for making the landfall. There is no light at Amherst to enable vessels to take a cross bearing and to know when they are abreast that place. As a consequence a vessel is sometimes set up to the northward on a flood tide, and instances have occurred of steamers having grounded on the Goodwin Sands. Two lights vertically placed (as at Vingorla) would meet the necessity of this case. As Double Island is one of the Burma lights for which a special due of 1½ annas per ton is levied, the two small lights of Amherst should be purchased and maintained out of Moulmein Port Funds; the original cost would not exceed Rs. 2,000 and the monthly up-keep about Rs. 60.

Double Island.

108. The light-house of Double Island is a good building, and so are the light-keeper's dwellings, but the landing place is very weather-worn and should be attended to. The iron crane is too old, the wooden beams supporting it are rotting away, and the whole rocky foundation requires considerable repairs. I would advise a lighter crane with a longer jib (say 5 feet longer than the present one), so as to plumb the basin where the boat lands stores and men. The Double Island light is a 1st order dioptric with a catadioptric prismatic mirror which intensifies the light to seaward. Only natives are employed here now, and they do their work well. The island grows excellent plantains and some other fruits and vegetables, but has a large number of snakes.

Cocos Island.

109. This light is under the care of a European head light-keeper. It is a 1st order dioptric light, seen all round. The column is of cast iron; the out-houses and keeper's dwelling are good. Table Island is large and fertile; yams and other vegetables, also fruits, thrive there. There are plenty of cattle and poultry. Sheds are provided for the cattle, who go out to the jungle in the morning and return to their sheds about 4 P.M.; the cows furnish a liberal supply of milk.

110. There are two landing places at Table Island, one on the south side available in the N.-E., and the other on the north side for the S.-W. monsoon. That on the south side is capable of much improvement at little expense and this ought to be done, because landing stores and men is rather a difficult operation now with a fresh northerly wind.

111. It had been notified for some time on the Admiralty chart, that Slipper Island lies considerably further northward. I was able during my brief visit (with the assistance of a little sketch map previously made by Captain Campbell of the I. G. steamer *Enterprise*) to rectify the position of Slipper Island relatively to the west coast of Table Island. The result (moving Slipper Island 3 cables further northward) has been forwarded to the Hydrographer to the Admiralty for the correction of the chart.

112. In a subsequent report I shall enter fully into the question of the best method of relieving and supplying all the coast and island light-houses. A further report will follow on the tolls which should be levied on shipping to pay off gradually the original loans for the erection of lights, and to meet the annual expenditure in maintenance of imperial light-houses in India.

APPENDIX B.

Report on the Question of Relief and Supply of Indian Light-houses, also on the necessity of periodical Inspection, by

COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

HAVING now personally visited all the off-lying light-houses of British India and Burma, and having communicated with those in charge of the lights, both European and native; having also had the advantage of perusing some valuable remarks on the above subject made by practical men like Captain Campbell, now commanding the I. G. steamer *Enterprise,* and his predecessors in command, Captains Guthrie and Edwards, I feel more competent to report on the question of relief and supply.

1. In the Bombay Presidency there are only 4 or 5 out-lying light-houses, and their relief and supply are effectually and cheaply maintained by the Port Trustees in the case of Bombay, and by the Department of the Commissioner of Salt Customs in the case of Piram Island, Vingorla rocks, and Carwar lights. But, as already pointed out in my former reports, a periodical inspection of all the lights in the Bombay Presidency should be undertaken by a competent officer, accompanied by a mechanical engineer who would make whatever changes may be found necessary in the limits of the arcs, or directions in which the lights shine.

2. The Madras Presidency has no other than shore light-houses, and all these are under the control of the Administrative Branch of the Madras Port Office, all the local Port Officers having the charge of their own lights. This arrangement seems quite satisfactory. Inspection of all the coast lights of this presidency was last year undertaken by the Port Officer of Madras.

3. In the Bengal Presidency, besides the several light-houses and light-ships connected with the port of Calcutta, there are only 3 or 4 coast lights, which are under the local Port Officers. All the lights are now annually inspected by the Port Officer of Calcutta.

4. With regard to the British Burma lights, it may be said that some difficulties present themselves in the matter of relief and supply; but much of the excessive cost is due to the fact that all operations for relief and supply emanate from Rangoon, whilst local Port Officers are not allowed to offer an opinion or suggestion on the subject of the lights situated at the very entrance of the port under their charge or control. On this question let us hear the result of actual experience by consecutive commanders of the I. G. steamer *Enterprise,* which vessel has for some time been employed on light-house relief duty.

5. Captain Campbell first describes the existing system, and then its shortcomings, as follows:—

(*a.*) "The system, as at present organised, involves the cost of maintaining a seagoing steamer for the special purpose of periodically visiting (once a month, if not oftener) all lights on the Burma coast and the Cocos Islands. The head-quarters of this vessel is Rangoon, from which place all the supplies and relief are sent.

(*b.*) "The supply of stores is supposed to take place twice every year, *viz.*, in April and November, these being the finest months in the Bay of Bengal.

(*c.*) "Instead, however, of this being the case, apparently from want of system, stores are supplied throughout the whole of the bad weather, during the S. W. monsoon, without any regard to their nature whether they may be damageable or otherwise. A reference to the store lists accompanying the various letters of proceedings submitted periodically from the I. G. steamer *Enterprise* will furnish particulars on this point.

(*d.*) "With a little forethought all requisite stores and supplies might be placed on the different light-houses at the times before mentioned (*b*), and strict attention to this would much lighten the duties of the vessel during the monsoon, and save a considerable item in the unnecessary wear and tear of the ship's boats and their stores.

(*e.*) "I am of opinion that the present system of supplying, relieving, and inspecting the different lights, from Rangoon as a centre, is a most costly and unsatisfactory one.

(*f.*) "A very great retrenchment might be effected, and a much better system of carrying out the work indroduced, if the several Port Officers, as per margin, were made responsible for the lights in the vicinity of their respective ports and if the administration of them, as far as regards supplies and establishment, were conducted locally. The means they have now at their disposal will, perhaps, be found adequate for the work of supplying the lights once every six months with stores and for the periodical visits of relief and inspection, without enhancing the cost of their present port establishments.

Bassein	to look after	Alguada.
Moulmein	"	Double Island.
Akyab	"	Savage and Oyster.
Rangoon	"	China Bakeer, Eastern Grove, and Krishna Shoal Light-vessel.
Rangoon	"	The Cocos Islands.

(*g.*) "As an instance of this I will take the Alguada and Oyster Reef lights, these being the two most difficult to communicate with during the south-west monsoon. No stores or men can be landed on the Alguada reef except in fine weather and in a smooth sea.

(*h.*) "Breaks in the weather occur frequently during the monsoon, and these opportunities must be taken advantage of. This can be done easily from Bassein, but a steamer leaving Rangoon has no means of judging the state of the weather at Alguada Reef and is often detained for many days before she can communicate. In October 1878, the *Enterprise* wasted 14 days before an opportunity occurred for landing stores at Alguada.

(*i.*) "The Alguada light-house is only 13 miles from Diamond Island anchorage, and a boat would have no difficulty during the fine intervals in getting out to it. Supposing the wind does freshen when out there, she has in the south-west monsoon a leading wind under shelter of the reef to return to her anchorage. Under these circumstances, I consider the schooner-rigged buoy vessel *Alguada,* about 60 tons register, attached to the Port establishment at Bassein,

> is quite capable of taking all supplies to the Alguada Reef, also to carry out any visits of inspection or relief that may be required, and this she could easily do in addition to her other duties.
>
> (*j*.) "Should any unforeseen emergency, such as sickness, occur at Alguada light, assistance could be signalled for to Diamond Island, and the sea-going steam tug belonging to the Bassein pilots could be sent out there at a very small outlay. In this way more prompt and less costly assistance could be rendered than by having to telegraph for and despatch the *Enterprise* from Rangoon."

6. Respecting the relief of Alguada light-house, Captain Guthrie, who commanded the *Enterprise* in 1877-78, states, "Rangoon is the head-quarters: from that centre the light-houses are provisioned for six months, generally in April and September." He then suggests that the Alguada Reef might well be relieved and supplied with stores from Bassein. In proof that boats can go to the Alguada occasionally in south-west monsoon, he says, "In the months of July and August I have found the Bassein pilots at the light-house paying a visit to the European light-keepers." He also states that "relief could be sent from Rangoon to Bassein by inland steamers or boats. What means the Port Officer of Bassein has at his disposal I am not aware, beyond the fact that some former Master Attendants have paid a visit to Rangoon in their boats, having brought their wives with them."

7. Regarding the Oyster Reef light, supposing it were placed under the Port Officer at Akyab, Captain Campbell says it could be stored for six months (that is, before and after the monsoon) by the schooner *Dauntless*. In my inspection report I have indicated how the Port Officer of Akyab proposes to entertain a life-boat for the benefit of the port, and also for relieving the Oyster Reef in bad weather from the Myou river, which is 9 miles due north of the light-house; from that river she could sail out with a westerly wind and weatherly tide to relieve the light-house.

8. Similar means to these might be made available at Moulmein for the relief of the Double Island light-house. A good life-boat stationed at Amherst would be of great use to the pilots, and could keep up the necessary monsoon communication with Double Island (*vide* remarks about boat work in paragraphs 11 and 12).

9. The port of Rangoon, with its Port Trust, similar to that of Bombay, has ample existing means for looking after the Eastern Grove and China Bakeer light-houses, whilst a sea-going steamer could occasionally inspect and relieve the Krishna shoal light-vessel.

10. With regard to the Cocos Islands, Captain Campbell says, "There is no necessity to relieve the establishment at Table Island more than twice a year at the very outside, and this would be done when the supplies are sent. It is a favourite station with the light-keepers, both Europeans and native, who are very healthy there. The men have also a good garden, plenty of poultry, and milk from the cattle bred on the island. No difficulty could be met with in getting men to serve there for a longer period than six months, if considered necessary."

11. In considering the question of relieving the off-lying light-houses of British Burma, it must be borne in mind that a row boat is necessarily the intermediary of communication between the supplying steamer and the light-house. And that although the steamer may be able to anchor a little way from the latter, yet it is useless attempting to relieve a light-house unless the water is smooth enough for the boat to go alongside it. Obviously, therefore, the system, which has hitherto prevailed, of keeping a supervision over all these light-houses from the distant port of Rangoon, could not possibly work well. Instances have occurred of the steamer *Enterprise* having to wait in the vicinity of a light-house for a week or a fortnight, before the weather moderated sufficiently to allow of a boat undertaking the relief. Such being the conditions, the proposals for placing the Savage Island and Oyster Reef light-houses under the Port Officer of Akyab, and Double Island under Moulmein, are undoubtedly much more reasonable than relieving them from Rangoon.

12. Captain Campbell in proposing the introduction of a better system of relief for the light-houses and light-vessels off the coast of British Burma—and these remarks are the more valuable from being the result of actual experience in bad weather—says, "It should be borne in mind that the work in connection with the light-houses is simply boat-work and can only be done in fine weather, when there would be no risk in boats putting to sea. Of suitable times the local Port Officers should be the best judges; and if the tides are taken advantage of, the work can also be done expeditiously. Throughout the last south-west monsoon I invariably found, on the days I could land at the lights, that the pilots at the several ports (Rangoon excepted) were out cruising in their boats, mostly open ones."

13. Regarding, therefore, the question of a more efficient system of relief and supply, it will be seen from the foregoing remarks that there is a remarkable concurrence of opinion between myself and Captain Campbell. On the point of economy that officer further suggests, "A reference to the Port Officers of Akyab, Moulmein, and Bassein will (I think) show how even a reduction could be made in their present port establishments, if the light-keepers were placed on the strength of those establishments and the reliefs done locally. This, at any rate, would obviate the necessity of keeping up the number of extra men now entertained in Rangoon for the purpose of furnishing reliefs, as the light-keepers, if a part of the Port Establishment, would be available for harbour duty when not employed at the light-houses, instead of going on leave as at present."

14. Under the foregoing proposed alteration in the system of relief and supply, the question of inspection divides itself into two heads,—*Firstly*, an annual inspection by a qualified officer, accompanied by a mechanical engineer who thoroughly understands modern light-house appliances and arrangements; *secondly*, a quarterly inspection by the Port Officer of the port under which the light-house is placed.

15. Captain Campbell's proposals are very similar to mine; he writes, "Beyond the supervision of the local Port Officer, who should visit the light occasionally, when the reliefs are effected, a yearly inspection made by a qualified officer, say from the Public Works Department or Marine Survey Department, who could report on the state of and repairs required to the structures of the light-houses and the lighting apparatus, is all that is necessary."

16. For this yearly inspection Captain Campbell says, "The services of a sea-going vessel might be required to make the round of all lights. This inspection might, if considered necessary, be made general and extended to every light round the coast of India and still cost less than the present system which is confined to Burma waters only."

Summary.

From the foregoing it will be seen that—

1st.—The outlying light-houses in the Bombay Presidency are effectually and cheaply maintained, but that a periodical inspection is desirable.

2nd.—That there are no outlying light-houses in the Madras Presidency, that the local lights are supplied and relieved by the various Port Officers in a satisfactory manner, and that an annual inspection of all has been undertaken by the Port Officer of Madras.

3rd.—That in the Bengal Presidency the lights are under the control of the local Port Officers, and are annually inspected by the Calcutta Port Officer, so that no changes are necessary.

4th.—That Rangoon should not be the head-quarters from which all the light-houses in Burma should be relieved and supplied, and that the present system is costly and unsatisfactory. That the Bassein Port Officer should have charge of the Alguada Reef light, the Moulmein Port Officer of Double Island light, the Akyab Port Officer of the Savage and Oyster Light-houses, and that China Bakeer, Eastern Grove, the Krishna Shoal light-vessel and the Cocos Island light should be supplied and relieved from Rangoon.

5th.—That an annual inspection of the Burma light-houses should be made by a qualified officer, accompanied by a mechanical engineer, and that a quarterly inspection should be made by the local Port Officers.

APPENDIX C.

Fourth Report on the Harbour of False Point, by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

THIS harbour was again inspected by me in the beginning of October 1879, exactly 2½ years since my third inspection, during which period three entire southerly monsoons have been effecting vast alterations at Reddie Head. The advance of the sandy head in a N.-N.-W.-½-W. direction has been at the average rate of 100 yards yearly; but, as a matter of fact, the increase during the last southerly monsoon has been much larger, 130 yards. This is, doubtless, owing to the excessive rainfall in Orissa during the past season and the consequent great outburst of water from the Jumboo and Bákood creeks, which has caused the extension of the sandy point to take a more favourable direction, *viz.*, N.-by-W.-½-W. The Port Officer informed me that during the freshets of September last, the combined ebb-streams from the Jumboo, Bákood, and light-house creeks occasionally attained a velocity of 5 or 6 miles an hour at the tip of the point, and washed outward a considerable quantity of the sand which had been thrown in from seaward by the swell of the previous four or five months. This action was formerly described by me in paragraphs 15 and 26 of my second report (August 1877).

2. On the whole, it may be said that the harbour has not deteriorated; indeed, in the vicinity of the outer black buoy, there is a deepening to the extent of about 3 feet. The sandy extreme known as Reddie Head has also considerably increased in breadth during the last three years, which is a decided advantage. It would be advisable if some small outlay were permitted for the erection of additional beacons on the head to mark its advance seaward; those at present erected are not sufficiently substantial, yet they have been invaluable to me in sounding the harbour, as they have enabled me to take the depths on the same lines year after year, thus rendering my comparisons more accurate.

3. While speaking of beacons, I would mention that Plowden's beacon is damaged and, owing to the growth of the adjacent trees, not visible (except with a good glass) from the outer anchorage. But, instead of repairing that, I would recommend the erection of another and better one at the north-west extreme of the trees at Plowden's Point; such a beacon in line with the light-house would form an excellent leading mark into the anchorage.

4. I am firmly convinced that the arguments I formerly advanced, in demonstrating the causes of the vast accumulation of silt between Reddie Head and Temple Point, are sound. Colonel Thomason, R.E., however has entertained the idea of absolutely cutting off the Jumboo and Bákood streams from the harbour in the hope of improving the sheltered area. Such an operation would, in my opinion, surely result in the utter destruction of the harbour and in forming a mere lagoon in its place. The reason for thus advocating the cutting off of those streams is the idea that the deposits off Temple Point are brought down by the Jumboo and Bákood.

5. My conviction is greatly strengthened by my late inspection, that what I advanced two years ago as to the cause of that deposit and the formation of the harbour truly represents the case. I stated in paragraph 8 of my second report—

> "All the black sand that is carried out of the Mahanuddy mouths and not taken out to sea by the current is rolled up the coast by the southerly monsoon swell with the fine white coast sand, and must be deposited off Reddie Point. Not a particle (so to speak) goes beyond the Point; there it is dropped, whilst a good deal of the muddy matter of the Mahanuddy, being more transportable, is held in suspension by the agitated sea, and is carried to the westward of the Point, where it is deposited in conjunction with the mud of the Bákood and Jumboo rivers. All the deposit that has of late years occurred between the extreme red point (on chart) and Temple Tree Point is not due to the Jumboo and Bákood only, but to those rivers and their parent stream, the Mahanuddy, combined."

6. It seems to me that those engineers who propose to improve the False Point harbour by either dredging out a considerable area or by cutting off the Jumboo and Bákood creeks, totally ignore the existence of the great Mahanuddy river, and the vast quantities of sand and mud which the freshets bring down.

7. During these freshets, which occur in August and September and run into October, there is but one continuous outflow of muddy water from the Mahanuddy, while the ocean tides are quite regular in their coming and going. The ocean flood, which runs up past False Point towards Balasore bay and the Hooghly, carries the disgorged water (saturated with silt) of the Mahanuddy towards Reddie Head, where it deposits the heavier material, the sand, (see paragraph 5). From Reddie Head the main stream of the flood takes a N.-W. direction towards the mouth of the Broni, but it throws off sufficient water to raise the sea level in False Point bay. Synchronously the freshets from the creeks in the bay burst out towards Reddie Head, and in the dead water, where these two silt-bearing bodies of water (from the creeks and from the sea) meet,—that is to say, in the space of at least 3 square miles off the land, between the mouths of the Jumboo and Broni creeks,—each deposits its silt over that area, the southern portion of which is quite sheltered from the sea swell; thus in absolutely still water great quantities of mud are deposited. This operation annually repeated has caused the entire west side of the harbour, and of the approach thereto, gradually to shoal, a fact, which is incontestably proved by comparison of the latest surveys with that of

Captain R. Lloyd, I. N., in 1841. The chart which accompanied my second report on this harbour showed the changes at three epochs, and most fully confirms the above remarks.

8. Thus, it seems to me a matter of certainty that to cut off the streams of the Jumboo and Bákood in the hope of improving the harbour (as proposed by Colonel Thomason) would result in turning False Point bay into a lagoon. I stated in paragraph 15 of my second report that "the combined streams of Bákood and Jumboo are the forces which prevent the bending inward of the point, but if *one-half* of these forces be rendered neutral by the damming of the Jumboo, it is unreasonable to expect that the sea will not take advantage of its opponent's weakness, and make Reddie Point encroach upon the harbour." But if *all* the force from inland are cut off, it is only reasonable to suppose that the deposit will extend the entire distance from Reddie Head towards the shore, halfway between Temple Point and the Broni creek.

APPENDIX D.

Fifth Report upon False Point Harbour, by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

BEING called upon by the Government of India for a full report on the present condition of this harbour and to say whether it is likely to deteriorate or not, I proceeded to False Point in the British India Steam Navigation Company's S. S. *Chinsura* in the end of March 1880. This vessel grounded in the shoal water outside of Hookytollah and remained aground for two days and nights—a circumstance which enabled me to observe the set of the currents and the effects which an immense object, a steamer upwards of 300 feet long, had upon the sands when she was lying there, exactly like a great groyne but detached from the shore, whilst exposed to the southerly swell.

1. Firstly, I must say that the present condition of the harbour (as reported by me in October last) compares favourably with its state three years ago, although the local engineers have recently resuscitated the opinion of Mr. J. P. H. Walker as to the necessity of adopting means to check the northward progress of the sand point (Reddie Head) which shelters the harbour. Mr. Walker said,—"I cannot too strongly express my anxiety about the changes now at work at the northern end of Dowdeswell island. The spit, which, *if kept under control*, will always maintain False Point as a harbour second to none in India, but if allowed to extend as the tides or land freshets may direct, will ere long turn it into another Coojung lagoon." Now I have endeavoured to explain in my four previous reports that "the tides and land freshets" are the forces which *maintain* the harbour, but here they are spoken of as antagonistic and detrimental, I must also point out that Mr. Walker was wrong in his theory and most unfortunate in his practice when the Bengal Government allowed him to make a trial of *controlling* operations about five years ago by means of brushwood groynes and stones laid in the sea to north-east of Hookytollah.

2. These control operations were renewed on a grander scale, but with similar result, in April of 1879, when about 20 large old iron barges (some 40 feet long) were sunk in the sea at the same locality; and now again a railway has been laid down with the object of transporting stone ballast from the harbour to the north-east sea-face of Dowdeswell island, where the iron barges were sunk. A bund, about 5 or 6 feet high, made of sand and mud, raised by successive Port Officers to enable them to walk dry-shod from Hookytollah to the sea beach, is now being utilised by the Public Works Department to carry their sleepers and rails; but as this bund is not broad enough for two persons to walk abreast, a good deal of additional earthwork is required. It may be expected that, when the rains fairly begin, the bund will be washed away in many places; and there is little likelihood of the railway being ready till the rainy season is over. Then the time and labour bestowed on this railway will be thrown away, because (assuming that the stones thrown into the sea would arrest the northward movement of the sand, which I dispute) before September the ocean current and swell will have changed their direction, and under any circumstances the stones could not be of any use till next March. In connection with this railway there is another point I wish to notice. The False Point engineers are carrying their line (as indicated by the double red lines on the accompanying chart of False Point) from Hookytollah. This is to utilise the narrow bund alluded to; but a glance at the chart will show that, by adopting the route shown in double blue lines, only half the distance would have to be traversed.

3. All such puny efforts can only end in failure and deplorable waste of money, but the False Point engineers seem resolved to abide by the opinion of Mr. Walker. As a matter of fact, far from preventing the point extending, the sunken barges did not stop the travelling sand, and the growth of the point, during last rainy season (as stated in my fourth report), was 130 yards in a north-by-west direction, whereas its normal annual extension is less than 100 yards. Reddie Point has grown 300 yards in the three years since Lieutenant Hammond's survey, and I repeat the opinion expressed by me in August 1876, with regard to those tentative operations to control that point by seaward groynes, that "no human effort, even were all the Customs, Revenue, and Port dues annually placed at the disposal of the cleverest engineer, would avail to keep False Point (Reddie Head) from its steady growth."

4. The winds and the waves are really the great enemies of False Point harbour, whereas the tides and land freshets are the forces which prevent its deterioration. In my first report (1876) I said "there is reason to believe that the vicinity of what is marked as Reddie Head will also gradually widen itself. Blowing the dry surface sand along, the winds are active agents in effecting this widening process. By a judicious use of hurdles and boughs of trees to intercept the sand, the south-west winds might thus be cheaply enlisted in the good work of filling up hollows;" and in an appended statement as to the requirements for the improvement of the port, I set down Rs. 3,000 for the purpose of filling swamps and hollows on Dowdeswell island. Subsequent experience convinces me that these simple works will prove of more real advantage than any others.

5. Recent visits to False Point in March and April last, have shown me that more mischief is done by the southerly winds than I had previously suspected. The point or shoulder

(marked P in red on chart) is claimed by the engineers at False Point to be what they have gained by sinking the barges there, but that extension of the coast line has been a gradual process and is, in reality, due to the south winds during three years. Anybody who wishes to be convinced of this action of the wind should stand for some minutes on the sandhills during the prevalence of southerly winds and witness how the sand accumulates to leeward of his legs. To demonstrate this practically, I requested Mr. Geary, the Port Officer, to put up some hurdles on the sand hills eastward of Hookytollah. In the beginning of April, with only the assistance of his boatmen, he erected seven hurdles, each 200 feet long and 3 to 4 feet high; they were made of upright sticks, let 3 feet into the sand, and interlaced with common jungle boughs cut in the vicinity. Before the 20th April, when I returned to False Point, the sand was up to the tops of these hurdles. By adopting this plan of arresting the sand with 10,000 or 20,000 feet of hurdles, placed in lines north-west and south-east, we might arrest thousands of tons of sand; and, when the monsoon changes to the north-east, the winds would confer still greater benefit by blowing the sand in a westerly direction and thereby filling up hollows. The useful method of planting the "Goats' foot" creeper, and other sand-binding plants (which are found in abundance in the neighbourhood), might be advantageously carried out here.

6. Not only at point P, but northward thereof to the tip of Reddie Head, this deleterious action of the wind during southerly and south-west breezes may be observed, and much of the mischief done may be prevented by the hurdle process. I am confident that the strong wind prevailing between February and August, always between south and west, is the great enemy to False Point; it blows the surface sand into the sea and prevents the upraising of the land at Reddie Point, where the sand is kept so low that high spring tides overflow it in many parts. If that driven sand were arrested by several rows of hurdles (see blue lines on chart) during the approaching south-west monsoon, we should catch hundreds of tons of sand which otherwise will be blown into the sea and washed by the waves towards Reddie Point, thereby causing that point to extend to the north-west.

7. The success of the hurdle process, which was initiated at False Point by Mr. Geary at my suggestion, has now been fully proved. I trust the Government of India will permit of its adoption for one entire year, beginning in February next. Between October and February, during which period easterly and north-east winds prevail, the sand which we have arrested will be blown into the hollows, and (if need be) other hurdles could be erected to prevent its being blown into the harbour.

8. The sand, when first caught by the hurdles, settles, of course, very loosely, but showers of rain consolidate and sink it, and the same hurdles are then ready to catch more sand. An overseer, with 50 coolies, working for three months, would cause an astonishing upheaval of sandhills. Unfortunately nearly three months of southerly winds have this year done their mischief already; but much real good may yet be done along the northernmost half mile of Dowdeswell island by setting up hurdles between June and September.

9. It is greatly to be regretted that the public money has been wasted by the sacrifice of those iron barges, and that a further waste is contemplated by the process of throwing all the stone ballast available into the sea off the sea-face of Hookytollah. That stone is valuable for building purposes and revetment along the harbour face of Dowdeswell island and cannot be recovered when once thrown in. There are now some two or three thousand tons of ballast collected near the landing place at Hookytollah, which is intended by the False Point engineers to be used for the above purpose. It is sad to think that so much useful material should be literally thrown away.

10. None but engineering works on a grand scale, as at Madras harbour, or perhaps on the minor scale adopted at Cutch Mándvi, would avail to withstand the force of such a sea as is found off Hookytollah between March and August. And, even supposing that a groyne, 200 yards long, had been successfully made by using great blocks of concrete at point P, what would be its effect? The False Point engineers need only go to Madras to obtain an answer. After witnessing the results at Madras I have no doubt that some sand would accumulate southward of the groyne, but to the north-west of it the sea would cut away the sand (as drawn in yellow line on the chart) and roll it round the point; very probably it would cut through the narrow neck marked with a yellow N. and do an immense deal of mischief thereby. Any accumulation to leeward of such a groyne would only be caused by the blown sand as at present.

'11. As the views of Mr. J. P. H. Walker, with reference to the improvement of False Point harbour, seem again to be finding favour, I deem it my duty to point out that he was the engineer who proposed Plowden's island as the best spot for a Customs establishment. At the close of paragraph 7 of Mr. Walker's letter (No. 288, dated Cuttack, 24th January 1871), to the Chief Engineer, Bengal Irrigation Branch, he writes—" It is proposed, therefore, to build a Customs establishment on Plowden's island, which possesses at present in a greater degree than any other spot the chief requisites, *viz.*, proximity and free access at all times of tide to the anchorage." This opinion has been falsified by events, for the silt has deposited off this spot to the extent of fully a quarter of a mile. The attempt was made to erect buildings on Plowden's Island, but was given up after a fruitless expenditure of Rs. 10,000 had been incurred. Subsequently, the same engineer selected Jumboo, which is now, through sad experience, found to be a fever-stricken spot, against which Mr. Robertson gave the following warning:—

> " The site is certainly not a healthy one, but will become more so in time as the jungle is gradually cleared and the swampy places filled up with sand, of which there is abundance in the ridges beyond Temple tree. I would not, therefore, advise the erection at present of any dwellings for the Master Attendant, the Custom's

officer, or any other officials, but only of the warehouse for goods intended either for shipment, or for despatch up-country. For some years the officials connected with False Point must live away from Jumboo island."

12. Mr. Walker's statements of the size of False Point harbour and the accommodation it affords were enormously exaggerated. In the letter above quoted he says:—" Good, safe holding ground of the following areas is found with the depths at low water noted below:—

Depth of water at low water.	*Area of anchorage in acres.*
From 20 to 24 feet	100 acres.
„ 15 to 20 „	240 „
„ 11 to 15 „	223 „
„ 9 to 11 „	434 „
„ 6 to 9 „	376 „
In all	1,373 acres."

13. I have prepared a separate piece of chart which represents in coloured tints the surface areas of water which furnish relatively the depths given by Mr. Walker. The tracing paper overlying it is ruled into squares, each of which represents one acre. Instead of 100 acres with 20 to 24 feet, there are only 50; instead of 240 with 15 to 20 feet, we find only 120; instead of 657 acres having between 9 and 15 feet water, we can obtain only 354; and finally, the number of acres having from 6 to 9 feet water must be reduced from 376 to 216. Thus, the actual area is only 740 acres.

14. Then, again, as to the number of ships of sizes which this harbour (according to Mr. Walker) can accommodate. He says—" Allowing 4 acres for large vessels and 3 acres for vessels of moderate tonnage running in and taking up their berths, which is not more than sufficient for safety to other ships lying at anchor in a strong current and in rough weather, there appears to be ample accommodation in the harbour for the following number of vessels:—

	Number of vessels.
For craft under 300 tons	125
„ vessels from 300 to 500	144
„ „ „ 500 to 800	74
„ „ „ 800 to 1,200	60
„ „ „ 1,200 to 1,700	25
Total	428"

15. We have merely to draw small circles over the tinted area to show how many vessels could really be *crammed* in. As for *" running in and taking up their berths,"* the idea is preposterous. Steamers drawing from 20 to 24 feet water must be fully 300 feet long. Even if she could swing round on a pivot, a vessel of that length will occupy a circle with an area of 9 acres. The largest circles on the chart (which represent a ship 300 feet long swinging round a pivot) cover 9 acres, and for all intents and purposes they are *outside* of the sheltered harbour, although within port limits. A vessel 150 feet long would draw from 12 to 14 feet water and require 4 acres (at the least) to swing round in; this is Mr. Walker's medium size tonnage. He declares there is room at False Point for 428 vessels, but the circles on the chart only allow about 278. But what would become of Mr. Walker's ships (supposing that only 278 were there) in a north-east gale? The truth is there is not comfortable room for 40 vessels between 300 and 1,700 tons.

16. These comparisons surely indicate that Mr. Walker's picture of False Point harbour is quite fanciful, but it has, doubtless, led the public to imagine the place to be of much greater capacity than it in reality is.

17. Accompanying this report I send that portion of the Indian Atlas which embraces the Orissa coast from Pooree to above the Dhumra River; also a lithograph showing the state of False Point harbour at four different epochs,—1835, 1858, 1868, and 1876. These will show that the port has certainly not deteriorated.

18. Looking at these two documents we can comprehend why the north point of Dowdeswell Island has advanced in a general north direction 3,500 yards since 1835. The reason is the coast above the mouth of the Bákood trends about north by east for 6 or 7 miles; whilst from the South Broni creek towards Palmyras Point the general direction is north-east; and this is also the trend of the coast south of the light-house. If Reddie Point at the expiration of other 40 years has advanced another 3,500 yards due north, the harbour will have the same general depths as now at its entrance.

19. The Bákood creek has widened (compare Lloyd's and Hammond's Surveys) since 1835. In passing through the creek, I could see that one side or the other is cut away during the freshets. This creek is the salvation of False Point harbour now, but in the next century it may have, by erosion, become vastly wider, and then it may happen that a south-east gale might offer such resistance to the ebbing waters of the great Mahanuddy as to force one-half its stream through the Bákood. Then the Bákood might become the enemy of False Point harbour by reason of its bringing more silt directly into the bay. Similarly, the Godavery River had been working mischief in Cocanada Bay for some 15 years, but fortunately a new mouth (through which the ebb stream and the freshets strike out to the north-east) has recently burst open: this, in my opinion, will prove a great benefit to Cocanada harbour, because the sand and silt will now be deposited in a line northward of Point Gordeware, thereby affording more shelter to Cocanada Bay.

20. I might here mention that there is now much greater similarity between False Point harbour and the Bay of Cocanada than in August 1876, when I made my first official inspection of False Point (see paragraph 16 of Report, dated 4th November 1876), and the corrected chart of Cocanada Bay might advantageously now be studied when considering any proposals for the improvement of False Point harbour.

21. The Kendrapara canal has been carried across the Jumboo creek. It is to be hoped that the Patamoonda canal will not be carried across the Chota Brahminee which feeds the Jumboo River. Mr. G. Robertson, C.E., wrote about eight years ago concerning this project: "During floods one of the principal feeders of the Jumboo River is the Chota Brahminee, an offshoot from the upper part of the Dhumrah. In the construction of the Patamoonda canal it is proposed to bund this river. The same remarks I have made on the bunding of the Jumboo creek apply also to this project. If the traffic of Orissa is to be concentrated at the Jumboo outlet into False Point bay, it appears to me that the stoppage of all the flood waters coming down the main feeders of the river is a matter for grave consideration." I entertain the same anxiety as Mr. Robertson regarding any bunding of the Jumboo River feeders.

22. Regarding the Bákood creek, I have already said it is the salvation of False Point harbour. During the freshets the stream of this river comes out with great force into the bay and combines with the stream from the light-house on the one side and with Jumboo river on the other; the united streams attain sometimes a velocity of 5 or 6 miles an hour off Reddie Point; and, by cutting away the inner side of that point, they remedy the evil caused by the waves and the winds.

23. What makes the Bákood of such general value to the harbour is, that from the month of February, when the southerly winds begin their mischief along the sandhills of Dowdeswell Island and till September, the tide coming from the Bákood is much strengthened by the wind. It is a very important fact that after the tide has been running ebb out of the Bákood creek in a northerly direction for 6 hours, the flood stream commences to come in from the Mahanuddy following the same direction and helps to raise the water in the harbour, but the regular flood stream comes in about one hour later around Reddie Head. The result is an apparent ebb stream out of the harbour for 7, and sometimes 8 hours.

24. This report on False Point harbour should not omit some notice of the extreme inconvenience which the merchants and the nautical public there suffer from the fact that, when the Government of India sanctioned the establishment of a telegraph office at False Point, some wilful engineer brought the line from Cuttack only as far as Jumboo and had the telegraph house erected there about 8 miles from False Point. Captains of vessels have therefore to send their boats round by the river channel to Jumboo, and if the tide be ebbing, grievous delay occurs. The inconvenience of a distant telegraph station was most acutely felt on the occasion of the British India Steam Navigation Company's steamer *Chinsura* having been aground for two days off Hookytollah.

25. The Board of Trade wished for a telegraph station at False Point, in hopes that passing vessels might be able to telegraph their arrival or departure; but under existing arrangements this is quite impossible. The daily weather reports from the shores of the Bay of Bengal announce the direction of the wind at False Point; but this is fallacious—the wind over the swamps of the Jumboo is not the same as that at False Point light-house near the sea.

26. I cannot close this report without again urging (as I did at paragraph 17 of my first general report, dated 4th November 1876, as well as at paragraph 9 of my preliminary report of 11th August) the importance of placing a small light, or, better still, two lights vertically 15 feet apart,. about 100 yards within the Reddie Head. The present False Point light is only the landfall light of Calcutta and maintained by the Port Fund at Calcutta. The up-keep of two small lanterns by False Point funds would only be about Rs. 50 monthly, and the original cost, as at Vingorla Point, Rs. 2,300.

27. In conclusion, it is my opinion that no deterioration will take place for half a century if the Jumboo, the Bákood, and Light-house creeks are not cut off from False Point Harbour. I am also of opinion that it is useless to throw away ballast into the sea with a view of preventing the inward growth of Reddie Point, but that much improvement will ensue at the mouth of the harbour if measures be taken every year to gather, by means of hurdles, as much sand as possible along the northern and eastern part of Dowdeswell Island, in order to arrest the sand before blown into the sea, which will have the effect of raising the general level of the island and of filling up all hollows. Then will Hookytollah become the sanatorium for the fever-stricken inhabitants of Jumboo and of the Delta generally.

APPENDIX E.

Sixth Report on False Point Harbour, by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

I arrived at False Point on the morning of the 23rd September, a boisterous and rainy day, during which no observations were practicable. However, the Superintending Engineer, Mr. Rhind, and the Executive Engineer, Mr. McMillan, had come down to meet me at Hookytollah, and I thus had an opportunity of ascertaining their views as to the requirements of False Point. These officers came from Cuttack in the small hired steamer *Eliza* and had to return there on the following day. They hoped to be able to send the steamer back to my assistance, in accordance with previous arrangements which I expected to be able to carry out, and which were notified in my letter to the Government of India, No. 71 (Surveys), 11th August 1880. But after their return to Cuttack I received a telegram stating that the steamer *Eliza* could not return, and that neither of the two vessels belonging to Messrs. Bullock and Wellsted was available.

2. I was, therefore, unable to carry out the intended observations on the strength and set of the tides, although the Commissioner of Cuttack had kindly instructed the Port Officer to place his row boat at my disposal, but it is impossible to execute work of that description by such means. Moreover, I ascertained that the depths in the harbour had so materially changed since Lieutenant Hammond's survey that it was simply impossible to plot accurate new work on the old plan. In fact a thorough and entirely new survey of the inner harbour and creeks leading thereto is absolutely necessary to meet all the requirements of the False Point engineers.

3. Although unable to register the set of the tides, I availed myself of the opportunity during my stay at False Point to take angles and measurements, in order to ascertain the amount of foreshore or high-water line which had been cut away from the inner side of Reddie Head and westward of the Tripod beacon. I found that since Lieutenant Hammond's survey in 1876, the erosion along the inner face of Reddie Head had been most extensive, amounting to an average breadth of 300 feet throughout a length of coast of about half a mile. This is no doubt due to the action of the waves produced by south-westerly winds, which blow between June and October, and this operation was quite expected and is not detrimental to the harbour.

4. I also proceeded from Hookytollah eastward along the line of rail constructed in the early part of this year to the sea-face of Dowdeswell Island, in which locality the 20 iron barges are said to have been sunk, and where, at a few yards within the high-water line, hurdles had been erected by the Port Officer.

5. These hurdles are standing monuments of the utility of accumulating the sand in the manner proposed by myself, as thousands of tons of sand have been collected and there remain, raising and maintaining the level of these hills some 4 or 5 feet above the adjoining ground and forming bulwarks which resist the encroachment of the sea. These sandy elevations (of which there are 7, aggregating some 1,600 feet in length) are about 100 yards apart, and through the intervening valleys the sea breached during July and August, the most tempestuous period of the S.-W. monsoon. In previous years the waves came over and levelled the sands as they met with no hilly obstructions.

6. The inference is, that, by multiplying the number of hurdles, the breaching of the sea may be prevented and the sand stored in still larger quantities; and when the N.-E. monsoon commences, this accumulated sand must be blown towards the westward and fill up several hollows. I need scarcely say that no impartial observer could fail to see the great efficacy of these hurdles for the purpose indicated.

7. With reference to the barges that have been sunk to the eastward of Hookytollah, with the object of causing the sand to deposit before it arrives at Reddie Point, I may remark that not the slightest indications of them exist. Indeed, so far from any deposit having accumulated, my observations and measurements show that a strip of sand of 300 feet in breadth has been completely washed away from that neighbourhood since Lieutenant Hammond's survey.

8. Hirherto I had made no actual measurements along the sea-face of Dowdeswell Island, *i. e.*, to the southward of its eastern shoulder, in order to test whether the sea had encroached or receded, but from the 27th to the 29th September I was able to walk in the coast-line and make observations, beginning at high-water mark, 2 miles below Hookytollah, and fix stations at intervals of about two cables along the coast, to a point north-east of that place. I found that for a quarter mile north and south of the the terminus of the railway, the breadth of the erosion aggregated 300 feet, whilst at a distance of one mile south of the terminus it amounted to 600 feet since the survey made by the officers of this department in 1876.

9. Further southward, due east of Prince Arthur Point, the cutting away has been less than 200 feet, but southward again, as far as Turtle Point, there is an average erosion of 300 feet. Looking at the trend of the coast line we may infer that the southerly winds of three seasons have been the agent in moving some considerable portion of sand to the north towards Reddie Head, but there can be no doubt that the residue has been carried up by the ocean swell.

10. I may mention that by angles taken on the sandy shore and at False Point light-house, I have been able to correct the chart for alterations in the sand banks off the mouth of the Mahanuddy, and to demonstrate that the principal entrance to that great river has, during the last monsoon, broken out upwards of a mile to the southward.

11. I have not been supplied with any reports made by the False Point engineers in reference to my published observations and remarks on the harbour, but in the Supplement to the *Calcutta Gazette* dated the 22nd September there is a printed note by the Chief Engineer (Bengal Irrigation Branch), which would make it appear that I considered the enormous annual accretion of sand at Point Reddie to be due to the action of the wind alone, whilst several engineers were of opinion that "the deposit of Reddie Point is caused by the waves and long-shore current rolling the sand brought down by the Mahanuddy along the sea-face of Dowdeswell Island."

12. If my previous reports are carefully read, it will be seen that I have not ignored the above action of the waves and the along-shore current. But I have emphatically protested against wasteful expenditure in attempts to arrest the sand by the means suggested by the engineers,—*i. e.*, ships' ballast filled in stout jungle-wood or bamboo gabions and deposited due east of Hookytollah. I have previously stated that the contemplated spurs or groynes to check the sand are at the wrong point, and to be of even the smallest service should be constructed more than a mile to the north.

13. Again, I would urge the Government of India to adopt the "hurdle method," which on a small scale has proved so successful, rather than sink money in an undertaking that, in my opinion, will be valueless. The Chief Engineer, Irrigation Branch (see *Calcutta Gazette* of 22nd September 1880), says that "to construct spurs or groynes to check the sand" is the *obvious remedy*, and that he would "gradually extend the spurs as the sand is accumulated." Knowing the terrific violence of the monsoon waves along that sandy shore, I venture to predict that by the end of July not a trace would be visible of any spurs constructed as proposed (see para. 12) before the S.-W. monsoon began.

14. On my late visit I saw how completely the sea had broken over the whole sandy promontory of Reddie Head, northward of the mangrove bushes, entirely levelling most of the hillocks which were there before the rainy season. I am convinced, if measures be taken to collect the sand hereabouts by means of hurdles, beginning such operations during the N.-E. breezes of the new year, that before the next rainy season we shall accumulate so vast a quantity of sand as to prevent that injurious breaching of the sea. It stands to reason that if the blown sand is formed into hillocks or dunes above high-water mark, these dunes, if topped with fresh hurdles, will not only gather ever-increasing quantities of sand, but, by destroy ingthe flat surface, will prevent the wind from carrying the sand to the continually growing sandy point of Reddie Head.

15. With regard to internal improvements in this harbour, I understand from the False Point engineers that it is their intention to throw out spurs of jungle-wood along both sides of the Jumboo and Bákood streams so as to produce a greater scour after half ebb, and to confine the young flood to a more permanent channel. I consider that these measures would be advantageous, and they entirely meet with my approval. The entrance channels to the above-mentioned creeks and the highway to the light-house could be clearly defined by the above means, and greatly to the advantage of cargo-boats.

16. In concluding this report, I must express regret that my proposal to have a small light or lights on Reddie Head (to be shifted northward as the point advances northward) was negatived even after the materials for the construction of the house and keeper's dwelling had been landed at Hookytollah. Again I would invite the attention of the Government of India to my remarks in para. 26 of my 5th report upon False Point Harbour. The grounding of the *Chinsura*, mentioned in that report, was partially due to the fact that there was no object to set as a cross bearing to False Point light-house.

17. On my recent light-house inspection tour I became convinced of the efficacy of two lights vertically placed some 15 or 20 feet apart, as an excellent distinctive mark for a port entrance. The two little copper lanterns, with dioptric apparatus, of the 6th order at Vingorla Point on the Bombay coast cost the small sum of Rs. 2,300, including the erection of the keeper's house, and there is every reason to believe that such a useful beacon could be erected at Reddie Head for about the same sum. The up-keep of these lights should not amount to more than Rs. 50 a month, which charge the port dues could easily stand, as they do not contribute to the maintenance of the False Point light, which is paid for out of Calcutta port funds. As a proof of the great efficacy of the two vertical lights, it has been frequently remarked to me by captains of the coasting steamers (and I have noticed the same myself) that the two lights of the 6th order, arranged as they are on Vingorla Point, are really visible at a greater distance than the 4th order, and vastly more costly, light on the Vingorla rocks.

APPENDIX F.

Memorandum on the Port of Cocanada and a new deep channel into the Godavery River, by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

THE old Godavery mouths are fast closing, whilst this great river has been, during the last year or two, cutting out a new channel, by which already vessels drawing 11 or 12 feet might be taken up the main river and close to the French territory of Yanam. There is reason to believe that, after the freshets of this south-west monsoon, the new mouth will improve itself and will require further examination.

2. The changes that have already occurred in the sand banks which lie to the north and north-west of Point Gordeware, and in the depths of water near the Black buoy, have doubtless benefited the port of Cocanada. If these shoals advance northward through the power of the river freshets between July and October, they will still further improve the port by furnishing more shelter to the shipping; and the improvement will continue year by year.

3. It will become necessary to move the Black buoy after every rainy season and perhaps oftener, as the northward advance of the shoal banks will form a serious danger to vessels entering the harbour. Notice will be given to the Hydrographer to the Admiralty of the great changes discovered this year and of the probable further annual encroachment of the sand banks upon the sea, so that due warning may be given on the charts.

4. From an inspection of our departmental chart of Cocanada, it will be observed how the bushes have extended themselves on the left bank of Coringa river entrance; the channel outside of the spot where the steamer *Coromandel* lies is narrower than formerly, and with a little dredging might be much improved.

5. But the channel which most requires dredging is that of Cocanada creek, off the mouth of which there are sand-lumps with only a foot or two of water over them at low tide. It is a great pity that the Cocanada groynes have not been carried gradually farther out; had this been done year after year the deep channel would be more confined and the formation of sand-lumps would be avoided. I strongly recommend an extension of the groynes for half a mile on a gentle curve (as shown in blue on chart); the Coringa ebb-stream will then be more confined on the landward side and will assist the ebb from Cocanada creek.

6. The dredger *Albuquerque* has done good service at Paumben by deepening the passage through the Horse-shoe sandbank down to 16 feet. I believe the vessel might now conveniently be spared for service in the Cocanada channel. After working at Cocanada for a year or two, the *Albuquerque* could be utilised in dredging out the new Madras harbour.

7. The Chamber of Commerce at Cocanada informed me that, on account of the deterioration of the Cocanada bar, an alternative way of getting goods from the town of Cocanada to the shipping had been proposed by the engineers, that is to say, by cutting a canal from the Cocanada creek to the sea beach a little on the town side of Vakalapudi, the opening of this canal into the sea to be between two stone groynes which should run out into water sufficiently deep for large cargo-boats at all times of tide.

8. With reference to the above project, I am of opinion that the engineers would find it more difficult, after the first year or two, to keep the mouth of that canal clear than to keep the Cocanada mouth clear, because the site of the proposed new entrance is much more exposed to the sea than the entrance of Cocanada creek. I think, therefore, the attempt to carry out such a project is likely to prove a failure, and certainly more costly than the simple measures recommended above for the improvement of Cocanada creek mouth. If two stone groynes be thrown out perpendicularly to the shore near Vakalapudi, the effect will most surely be to accumulate sand and mud on either side according to the season, and in 2 or 3 seasons the sand would pass round the ends of the groynes; then would come infinite trouble in keeping the mouth clear.

9. I am of opinion that, owing to the bursting out of that new Godavery mouth and the consequent changes spoken of in paragraph 2, the harbour of Cocanada (by which expression I mean that portion where the shipping now lie) will not now, and perhaps not for the next dozen years, be liable to become shallower. As a matter of fact (see tracing of Admiralty Chart with this letter) during the 22 years that have elapsed since my survey of Cocanada bay, the 5-fathom line has advanced 1½ nautic miles in north-eastern direction towards the present position of the Black buoy; whereas in the harbour where the shipping lie, the 5-fathom line has only advanced three-quarters of a nautic mile. This shows the beneficial character of the growth of those north-east banks. It may truly be said that the sheltered anchorage of Cocanada is now improving.

APPENDIX G.

Memorandum on the Port of Cocanada by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

REFERRING to the sanction accorded, in paragraph 3 of letter No. 2339 S. (Surveys), dated 3rd September 1880, to my inspecting the mouth of the Godavery, I have the honour to report my visit to Cocanada, which place I reached on the morning of the 4th October, and remained there till the night of the 6th October.

2. The Port Officer, Captain Gillham, took me in the *Lady Mary Grenville* to the Godavery mouth, where I found that the expected improvement in the depths of the channel had already taken place, and that the water northward of the mouth, in the vicinity of the black buoy, had shoaled considerably, so that it becomes necessary for the safety of navigation to move that buoy to the eastward about half a mile, as anticipated in the 3rd paragraph of my memorandum on Cocanada, dated 26th May 1880.

3. The Port Officer stated it to be his expectation that a considerably greater change in the sand banks, as well as in the contour of the high-water line of Godavery point, might result from the prevalence of heavy weather in the bay at the change of monsoons; and that a preliminary examination of the soundings would have to be done over again later on.

4. As the sanction of the Madras Government has been accorded to my having the steamer *Margaret Northcote* in February next, and, as the examination which I contemplate making in her would commence at Paumben and finish at Cocanada, I considered it best to postpone any exact measurements and soundings until that period, when the north-east winds will be finished and the banks off the new Godavery mouth will have assumed some definite shape.

5. Meanwhile, a change in the buoyage is necessary; and, as the system at present in vogue at Cocanada is unlike that of other ports, it should be at once assimilated to the newly defined method sanctioned in the Government of India Resolution published 30th September 1880.

6. At all the ports of India it has been customary to place *red* buoys on the port hand and *black* buoys on the starboard hand. Cocanada has hitherto been the exception; *there* both a red buoy and the black buoy are found on the port hand when a vessel enters. This arrangement has been in force for several years, and seems to have been handed down from Master Attendant to Port Officer.

7. In January of this year the iron barque *Afton* was endeavouring to reach the Cocanada anchorage; the casualty report furnished to this office states that the master mistook the red buoy for the black one. The probability is that, seeing red and black buoys, he thought it proper to haul in between the two; but in so doing the vessel grounded on the sand-banks which are supposed to be guarded by the black buoy. This grounding might have been occasioned by an error of judgment on the part of the captain; but under the newly-published rules the course taken by the *Afton* would have been quite correct.

8. It is imperatively necessary, therefore, that the altered system be enforced; and the present Port Officer, Captain Gillham, has already proposed to take away the large *red* buoy and place it north-eastward of the new Godavery sand-banks, about half a mile eastward of the present position of the *black* buoy—this latter buoy to be removed altogether, as it is out of place, besides being too small, and it cannot be seen any great distance.

9. I quite agree with the Port Officer that the large red buoy, with pole and basket, so placed, will be a far better guide; and, as it will not have to encounter such heavy seas at the new position, there is less chance of its being washed away.

10. On the occasion of my visit I took angles and bearings which showed that Point Godavery had, during the last monsoon, extended about two cables northward, and its inner or western side had been slightly cut away (these operations of nature being precisely similar to those which take place at False Point). But, in outward appearance, Point Godavery seemed much the same as in April last, and the actual extension or erosion of the point can only be determined by placing some fixed object there, so that local measurements may be taken from it.

11. In my opinion a wooden tripod (topped with a large-sized basket, on a pole) should be erected on Point Godavery, well within the high-water line, so that there would be no chance of its being cut away by the sea on one side, or when the river freshets come down. The Master Attendant of Madras concurred with me in the advantage of such a beacon, and, if sanction be at once accorded to its construction, it might be ready by the middle of February, when I myself could select the most suitable site for it and fix it in trigonometrically.

12. Independent of the value to navigators, as a sea-mark visible from a much greater distance than the buoys are now visible, its utility as a fixed point for any subsequent triangulation of the port is unquestionable. The Port Officer could then take lineal measurements in several directions from the beacon, and be able to report the changes, as they occur from time to time, to this department, in the same manner as adopted at False Point, at my request, and ably carried out by Mr. Geary, the energetic Port Officer of that place.

13. By the adoption of those operations this office would be kept thoroughly informed of important changes. There is no doubt that the natural forces which have scoured out the

new deep channel into the Godavery must have been in operation for the last four or five years; but the changes at the sandy point were only recognized by the Hope Island light-house-keeper within the last two years. This may be accounted for by the fact that the point is distant some five miles from the light-house and seven miles from Cocanada, and only by means of angles and true bearings taken with accurate instruments could it be ascertained whether either an extension or erosion (even to the extent of a quarter of a mile either way) had occurred.

APPENDIX H.

Report upon the proposed harbour of Marmagao by COMMANDER A. DUNDAS TAYLOR, *late I. N., Superintendent of Marine Surveys.*

IN my former reports I have spoken of Marmagao as it is *naturally*, *viz.*, a harbour for small craft, with some partially-sheltered anchorage for vessels of moderate draft; the formation of a more sheltered harbour appears to be now in contemplation, with a railway from above the ghâts having its sea terminus at Marmagao.

2. In my second report (14th May 1877) I have stated the possibility of a ship loading at Marmagao port, where there is always a greater depth than 4 fathoms. Within the last few years ship-builders have gone on increasing the draft of their vessels, and at the present time we often find a British India coasting steamer going round from Calcutta to Bombay with a draft of 22 feet. It is, therefore, evident that in the construction of harbour works provision must be made to shelter this larger class of vessel. To meet that requirement a breakwater must be thrown out from the west extreme of Marmagao fortress, such as represented on the accompanying plan; and I understand that this is the recommendation of Mr. Sawyer, the Engineer-in-chief, of the proposed Marmagao-Hubli railway. But supposing this breakwater to be the length of that at Kurrachee (1,500 feet), it would give but little increase to the deep-water area; nor would the additional sheltered anchorage gained be commensurate with the cost of such a work. In point of fact, with such a breakwater, there would only be sheltered anchorage for five or six vessels of sizes, the largest drawing 21 feet and the smallest 15 feet.

3. The recent examination by the Survey Party under Lieutenant Petley, R.N., has brought to light the existence of a dangerous rock carrying only 12 feet on it at lowest tides. This rock lies about 1,500 feet E. by N. of the landing place, under Marmagao fortress, and has surrounding depths of a little more than 3 fathoms; but unless this rock is removed, the port is deprived of one good berth for a ship of 16 or 17 feet draft.

4. A breakwater, as described in paragraph 2, would only cut off about one-eighth of the swell that rolls into the bay; and I am of opinion that, without some considerable shelter afforded by another breakwater on the northwest side of the harbour, this port could never be of more than second or third rate importance. Unfortunately the north side of the harbour (where rocks and shoals extend halfway across from Cabo and Caukarso towards Marmagao) has only been partially examined. The Cabo shoals and reefs have yet to be surveyed, and it is greatly to be regretted that this was not done when the Marine Survey Party was there. I had arranged that the party should recess at Goa during the S.-W. monsoon in order to witness and report upon the effect of the ocean swell in the approaches to the harbour and the inner bays. But the health of the officers was very indifferent and the Goanese Government could find no accommodation whatever for the party, so that I was compelled reluctantly to order them to Bombay.

5. It was the wish of Mr. Saywer that the Marmagao side should be sounded sectionally on two scales, the larger scale having the lines of soundings only 25 feet apart; but, knowing that so elaborate an examination would occupy more time than could be spared, because it was essential that smooth water should be had, and fearing that the party would not produce a complete survey of the whole entrance of the bay, I recommended that one scale only should be adopted. Just as I anticipated, the southern half only has been done, whilst the northern foul ground remains to be examined next season, and, until that work is accomplished, we cannot tell whether that rocky ground is favourable for the construction of breakwaters at a reasonable cost.

6. It would be ridiculous to call Marmagao a first class harbour, unless a breakwater were constructed to keep out the swell from the west and north-west; and there cannot be a doubt that all these protective works would cost nearly half a million stearling.

7. On my late visit to Goa in June last the coasting steamer went into Agoada bay, but there was too much swell for a boat to come off to land me. We then steamed away, passing close to the Cabo reefs, which afforded me an unexpected opportunity of viewing from seaward the approaches to Marmagao river during rough weather. The sea was breaking over the Cabo reefs halfway across to Marmagao, and I have little doubt in my mind that after a minute examination some suitable sites might be found for one or more breakwaters there. These shoals are thoroughly well defined by the sea breaking over them in bad weather, whilst the passage into Marmagao roads was perfectly clear. My boatmen could not take me to Marmagao as the S.-W. monsoon had thoroughly set in, but from the southern slopes of Cabo hill I afterwards witnessed, with a telescope, the state of the sea at Marmagao landing place, which I consider (as stated in paragraphs 5 and 6 of my first report) to be generally smoother during the monsoon than at Carwar pier.

8. I may mention that the Survey Party under Lieutenant Petley found, on examination, that this entrance into Marmagao roads is considerably broader than exhibited on previous charts; such being the case, it is perfectly practicable to make the Marmagao breakwater somewhat longer than proposed. It might be commenced from the north-west point of the peninsula, so as to give a very much larger extent of deep water and sheltered anchorage; but the cost would probably be doubled. Such a breakwater would cost about £250,000— a sum

which is not likely to be spared before it becomes known whether, when completed, that portion of the Marmagao-Hubli railway which lies below the ghâts will pay its working expenses. From my knowledge of the country, and the poverty and lack of energy of the inhabitants of Goa, I should say this was very doubtful. Moreover, the provinces of Salsette and Embarbacem, through which the railway will run, are already provided by nature with excellent water highways, with which it is impossible the railway could compete.

9. But if the smaller breakwater, as proposed by Mr. Sawyer, were now constructed, we must content ourselves for all time with a smaller sheltered area, for it is quite unlikely that the additional outer breakwater (as depicted in *red* on the plan) would afterwards be constructed.

10. I here wish to point out that the conditions at Carwar for breakwater construction are more favourable; the splendid granite of Carwar is to be had on the spot at the very root of any breakwater that may be devised. But what stone is to be used at Marmagao I know not. The Goa laterite, as I have pointed out at the close of my first report (dated 26th March 1877), is admirably adapted for *building* purposes; but recent operations with that kind of material at Madras have proved laterite to be very unsuitable for forming a rubble mound beneath the water, for there it was found, in a measure, to dissolve. Moreover, I believe it to be a fact (which may be verified on application to the engineers of the Madras harbour works) that it took 50 per cent. more to complete 100 lineal feet of the rubble mound of the north breakwater where laterite was used, than for the same length of mound on the southern breakwater where granite had been introduced.

11. With regard to Carwar, permit me to say that if a breakwater, 1,500 feet long, were constructed (from the point P, as marked on the chart of Carwar), nearly as much sheltered and as deep anchorage would be gained as Mr. Sawyer expects to obtain by his proposed breakwater at Marmagao. Now it is obvious that the Carwar breakwater might be, at any subsequent time, considerably increased in length, and much more extensive shelter provided there.

12. On the contrary, at Marmagao, it is not practicable to extend much further Mr. Sawyer's breakwater, so that the sheltered anchorage cannot be ultimately increased unless a heavy breakwater be formed on the north-west side of the harbour.

13. Another advantage peculiar to Carwar is the possession of that deep inlet—Beitkul Cove—which is invaluable as a wet dock. Colonel Thomason, R.E., who inspected Carwar with me in 1879, requested the District Engineer to take borings throughout the Cove; the result of this was most satisfactory, as a stratum of 17 feet of liquid mud was found to form the bottom of the Cove. This mud might be dredged out after the outer-dock walls are built, and these could be made to impound some 20 acres of perfectly smooth water having depths of from 25 to 30 feet. I think, therefore, that Carwar possesses greater capabilities of becoming a first-class harbour; whilst Marmagao, if the breakwater be not commenced in the first place from the outer head, can never expect to be more than a second-rate harbour.

14. Marmagao, with merely the addition of the small breakwater proposed by Mr. Sawyer, is one of those ports which cannot be entered by large steamers in safety during stormy weather in the night. The same may be said of Madras and Colombo (when the harbour works are finished), of Galle and of Kurrachee. One great disadvantage to a vessel arriving in the vicinity of Marmagao harbour by night during bad weather would be that she must heave-to and keep out at sea until daylight.

15. On the contrary, the port of Carwar has a magnificent natural external breakwater (the Oyster rocks), well lighted, and behind which vessels can run and anchor in perfect shelter at any time of the night, and at any season of the year. Moreover, this natural shelter can easily be improved by artificial works, which may extend over any number of years without interfering in any way with the harbour anchorage just outside the Beitkul cove, and year by year, as these works of the Oyster rock breakwater advance, the swell which enters the bay must be more broken and reduced.

16. I deem it my duty thus to point out the contrast that would exist between Marmagao and Carwar, if artificial works for shelter were constructed at each place, because I have been told by several persons who had read and were interested in my former reports, that I appeared to think more favourably of Marmagao; and they inferred that it was my opinion that under any conditions (whether as a natural harbour or one improved by breakwaters) Marmagao would have the pre-eminence.

17. It is impossible to discuss the question of lighting the approaches to Marmagao, or indeed to make a full report upon the proposed harbour, until the Marine Survey is completed; but that several buoys will be needed to mark the shoals, and that other lights will be required besides the revolving light now shown on Agoada headland, cannot be doubted.

18. Before concluding this report, I would make a few remarks regarding what I consider the impracticability of transferring the commercial capital of Goa. Owing to the exceeding unhealthiness of Old Goa, a new Viceroy, nearly two centuries ago, brought instructions from Portugal to build the new capital city at Marmagao, where a fortress had been originally constructed by Vasco de Gama. But it appears that the new Viceroy only moved the seat of the Government as far as Panjim, which was then a small village. After erecting a few official buildings and spending some £25,000 at Marmagao, the scheme of removing the seat of Government was abandoned by Royal Decree in 1712; and this after one Governor General had made the place his residence for some four years. In 1759 Panjim became the recognised capital and has since so remained.

19. The popular idea appears to be that Marmagao will now supersede Panjim as the principal town in Portuguese India; but I have grave doubts of such an event occurring. In the first place, there is a very considerable export and import trade at Panjim carried on

during the fine season (*i. e.*, for nine months of the year); the territory of Goa is remarkably adapted by nature for water-borne traffic, and the position of Panjim is central, upon which numerous rivers and creeks converge. Only recently the Goa Government has connected by canal the Chapora River with the Rio de Mapuça,—the northern affluent of the Goa River,—so as to bring by water the produce of the northern portion of the Goa country.

20. Of course it is well known that during the south-west monsoon at ports on the west coast of India, where there are no harbours, all sea traffic ceases, and the country may be said to take its sleep. Notably is this the case at Goa, which is, without doubt, a poverty-stricken country, and the inhabitants necessarily without energy.

21. It is hopeless to imagine that the shifting of the principal town, or the construction of a harbour at Marmagao, will ever rouse the country into anything like activity. With the monsoon swell rolling into the Marmagao River, the up-country boats would not dare to face the sea in attempting to reach Marmagao. The present water-borne trade of Goa would then, as now, lie stagnant during the short three months of the stormy season; afterwards waking up into life with its centre at Panjim, as hitherto.

22. If any works are undertaken at Marmagao, it will be necessary to create a maritime community; for at present there are neither seamen nor boats, and there is no doubt that a new class of sea-boat would have to be introduced and seamen supplied from British ports.

23. In conclusion, I would add my opinion that no branch railway from Bellary, through the Southern Mahratta Country to the coast, with its terminus at an artificially-constructed harbour, could be expected to pay in ordinary times; but what must be considered is its great value in times of famine. Had there been a railway from Bellary to Carwar during the Madras famine of 1877-78, it would have been the means of saving thousands of live and millions of money.

APPENDIX I.

Notes on Marmagao (Goa), Portuguese India, by NAVIGATING LIEUTENANT EATON W. PETLEY, R.N., F.R.G.S., *Assistant Superintendent, Marine Survey of India.*

There has been much written concerning Portuguese India, more especially relating to the old city of Goa, its churches and other architectural buildings; but the little village of Marmagao has been almost forgotten, although nearly two centuries ago it was, for a short time, actually the capital of Portuguese India.

As some interest is now being taken in the proposed scheme for constructing a harbour at this place, as also a railway from Marmagao to Hubli, the present is, perhaps, a favourable opportunity to offer a few geographical and historical remarks on the little village which, should the proposed works ever be carried out, may again rise into some importance.

Marmagao peninsula, which lies about 5 miles to the south of Agoada head, is situated on the left bank of the Zuari river, and is connected with the mainland by a narrow strip of sand about a quarter of a mile broad and elevated some 10 feet above the sea. The whole peninsula is composed of laterite, and the shore is fringed with heavy boulders of that rock, which have crumbled and fallen from the cliff into the sea. The summit of this peninsula is a table land, about 180 to 200 feet high, and is bare laterite covered with loose stones, with here and there, where a little earth has collected, patches of grass. Remains of the old flag-staff, of the look-out house, and what would appear to have been the soldiers' quarters are said to be traceable amongst the ruins on the plateau. The slopes of the hill, which are very steep and present a bold appearance seaward, are covered with thick jungle and scrub.

The Zuari river, on the left or southern bank of which the village of Marmagao is situated, is the largest river in the Goa territory. Its southern branch rises in the ghâts in the province of Astagar, and the eastern branch at Digui ghât in the province of Embarbacem; these streams unite at Sanguem (about 35 miles from the sea), thence called Rio de Sanguem, till joined seven miles further down by another affluent, the Rio de Paroda. The united streams then divide the provinces of Ponda and Salcette (there known as the Rio de Rachol), and, after passing the narrows between Salcette and the Ilha de Goa, this river opens out into the bay of Marmagao (called by the Portuguese Barra de Mormugâo). Between Ponda and Ilha de Goa there is a narrow and tortuous water communication from the Zuari to the Rio de Goa: this waterway is useful for native boats which bring down produce from the southern provinces to Panjim, especially during the S. W. monsoon, when it is impossible for them to proceed to the capital *viâ* Marmagao Bay.

Marmagao is the name of a small fishing village, but applies also to the fortress and bay; the word is said to be of Sanskrit origin, meaning "the village of pearls." It would appear that pearl-fishing was an old industry in Marmagao bay; this, however, was stopped, as it was discovered that the commandant of the fortress appropriated the whole of the profits for his own benefit!

The fortress of Marmagao is still in a very fair state of preservation, but nearly all the buildings within it are in ruins, especially the Viceroy's palace, the hospital, and barracks having but the outer-walls standing, and are now being overrun with thick jungle and scrub, which are forcing their way through the interstices of the walls. The fortress owes its existence to the great Viceroy Don Francisco de Gama, Admiral of India, and was commenced in the year 1624; the inscriptional slab, referring to this event and bearing the date of April 1624, is still to be seen over the entrance gate. At the commencement of the building of the fortress, Signor Fillippe Nery Xavier (in his *Gabineto Literario das Fontainhas*) states that the Admiral enforced the municipality of Salcette to pay the expenses of the building, but in *Borguejo D' Historico das Communidades* it is said that, as early as 1643, the village community were asked only to contribute a sum of money for the payment of the garrison, and later on, in 1668, the people contributed for the pay of one hundred soldiers.

During the latter part of the 16th and the early part of the 17th century several severe epidemics had appeared at old Goa, and the place was becoming notorious for its unhealthy character. In 1635 an epidemic of such extreme virulence broke out that nearly the whole of the inhabitants deserted the city, and took refuge in the surrounding villages, more especially at Panjim, then a small village, and situated at the entrance of the Mandevi river. In 1670 the authorities began to consider the advisability of transferring the seat of Government from the old city of Goa, which had rapidly declined from its former reported splendour and greatness, to the village of Marmagao. The proposal for transferring the capital city to Marmagao was originally made by Count de Alvor, then Viceroy of Portuguese India; but the project, through some unexplained cause, appears to have remained in abeyance for some years until the newly-appointed Viceroy, Count de Villa Verde, brought instructions from the Home Government to build the new city at Marmagao. He does not appear, however, to have carried out these instructions, but moved the seat of Government to Panelim, a small village in the suburbs of the old city. The Count de Alvor was at this time (1683) Prime Minister in Portugal, and he prevailed upon the King to insist on the works already commenced at Marmagao being proceeded with. During the next 12 or 14 years very little progress appears to have been made on account of the difficulty of obtaining building materials, but the Home

Government attempted to solve the question by ordering the demolition of the grand old buildings of Goa and the materials to be carried away to Marmagao, there to be utilised in the erection of the new city. These orders were, however, again disregarded by the Viceroy, as the inhabitants, judging from past experience, feared there was little chance of the newly proposed city rising into any importance, whilst there was every chance of the old city disappearing altogether, so that in all probability they would be left entirely without a capital. At last, in 1684, building works were pushed on, and the Governor's palace, the custom house, the hospital, the court-house, and a gunpowder magazine, together with two or three convents and several minor official residences, sprang into existence; at the same time the ascent from the bay to the fortress on the summit of the hill, consisting of a flight of 152 stone steps, was constructed. On the completion of these buildings, at the end of the 17th century, the then Viceroy (Caetano de Mello e Castro) removed the seat of Government to Marmagao, and to which place, in 1703, he proceeded himself, whence the affairs of the country were administered. His residence there does not appear to have been of very long duration, as about 4 years afterwards the whole scheme was abandoned, and after expending upwards of £25,000 the works were, by Royal decree, suspended in 1712, and Goa was again nominally the chief city. The old city, however, still maintained its notoriety for extreme unhealthiness, and in 1759 the Viceroy, Count de Sandomil, proposed Panjim as an eligible site for the capital; this was sanctioned by the Home Government, and Panjim has since been so recognised. An attempt was made in 1774 to enforce the return of the people to the ancient capital and to rebuild it, but it was ineffectual and Velha Goa was abandoned.

Marmagao contains a church and three chapels. The church, in which there are 5 altars, was built in 1569, and the first mass was celebrated on the 5th April 1570. There are several confraternities belonging to it, the most important of which are Guia, Bom Jesus, and Santas Almas. The chapels, which are all dedicated to the Virgin Mary, are small; one named Candelaria is in the village; another named Merces is at Vaddem; and the third, Desterro, is in the fortress. The patron saint is St. Andrew, whose feast is annually celebrated on the 30th November, but not with any of its former splendour, owing to the extreme poverty of the people. The fortress has within its limits several wells or fountains, the most important of which bears the name of St. Ignatius. The tradition is that it springs from a gold mine—a term derived in all probability from Fonte de Oiro (golden water) on account of its exceptional purity. The Royal Coat-of-Arms of the Kingdom of Portugal is placed over the entrance. The other important spring is situated near the Novo bastion and is said to contain sulphur; it was built and paved in the year 1203. These springs are still in a good state of preservation.

There are two inscriptions in Marmagao over the gateway of the fortress, copies of which are given below:—

Reinando em Portugal o Catholico Rei D. Filippe III deste nome, sendo Vice-rei deste Estado 2; *vez.*—D. Francisco da Gama 4; Conde de Vidigueiva Almirante da India, do Conselho d'Estado de Sua Magestde, e seu Gentil-homem da Camara fez esta Fortaleza. E lancou apedra aos . . . de Abril de 1624 a qual se fez Co . . . tas Terras concederam per . . dellas.

Literal Translation.

"Reigning in Portugal the Catholic King D. Filippe III of this name, and being Viceroy of this State the second time D. Francisco da Gama, Admiral of India, of the Council of State of His Majesty and His Gentleman of the Chamber, this fortress was made, and the corner stone laid on the . . . . of April 1624, which was made with (money from) lands . . . granted for . . . of them."

The other inscription * (restored) is as follows; the original is considerably mutilated:—

Reinando a Magestade do Catholico D. Filippe 3° N. S. Governando este Estado o Vice-rei Pero da Silva mandou a cidade de Goa pelo Seu Capitáo D. Filippe Mascarenhas, e Vereadores Luis D. Pedroza da Cunha, Bartolomeu de Quadros, e Lourenço Carvalho, Juizes das Communidades B. T. da Silva, e Bento Falcáo de Moraes, Procurador da Coroa Antonio de Souza, e os Mestres Paulo Moniz, Ignacio Domingues, Miguel Joao, Antonio Moreira, fazer esta obra tao necessaria e importante á fortificacáo de toda a ilha de Salsette nesta de Murmugáo com o parece do ditto Vice-rei e do povo desta Cidade com o dinheiro do Consulado. Principiada em anno de 1638.

Literal Translation.

"Reigning the Majesty of the Catholic D. Filippe III Our Lord, governing this State the Viceroy Pero da Silva, the City of Goa (Municipality) caused (or commanded) through its Captain D. Filippe Mascarenhas, and Members of the Municipality (or Aldermen) Luis de Pedroza da Cunha, Bartolomeu de Quadros, and Lourenço Carvalho, Judges of the Communities B. T. daSilva, and Bento Falcáo Moraes, Attorney of the Crown, Antonio de Souza, and the Architects Paulo Moniz, Ignacio Domingues, Minguel Joáo, Antonio Moreira this work to be made, so necessary and important to the fortification of this island of Salsette in this of Murmugáo with the consent of the same Viceroy and of the people of this City with the money of the Consulate. Begun in the year 1638."

The fortress of Marmagao is now converted into a convict establishment with a garrison consisting of a Commandant, a Major, Captain and Lieutenant, with a guard of 60 men.

The village consists of a number of poorly constructed huts scattered amongst the cocoanut trees; the church and chapels appear quite deserted; indeed, the whole place presents the appearance of neglect and decay. The Government buildings erected at the close of the 17th century are now mere heaps of ruins, the only traceable remnants of former grandeur being the fine old church, which has at least been a little less neglected than the other buildings.

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* Copied by Mr. P. J. Falle of the Marine Survey Department.

The villagers, the greater number of whom are fishermen, are very independent and appear unwilling to work even when it is offered them. The present population of Marmagao is about 800, who are mostly Christians.

The climate of Marmagao changes with the seasons, the most trying period being just before the rains in the months of April and May, when the heat is excessive; the healthiest season—called by the Portuguese "Terraes or land-wind season"—is from November to February, the prevailing wind being then N. E.; the atmosphere is beautifully clear, and the sanitary condition of the place is satisfactory. The most unhealthy times may be termed the "transition periods" and occur in March–April, and September–October. The monsoon rains generally commence in the middle of June and last until September, during which period it is very cool and pleasant. The month of October is remarkable for the very heavy dew that falls at night. According to Portuguese authorities, the average annual rainfall is about 107 inches, the maximum temperature is 90° F., and the minimum 73° F.* Some severe epidemics have passed over the village at different periods, and about two years ago (1878) it was very nearly decimated.

One of the first actions of the great Vasco de Gama was to establish a mint at Goa; many of the coins have up to the present time been the current money of the country, but as these coins will be now changed under the new treaty, it will perhaps be interesting to record their old values:—

Gold.

	Reis.
Pica or Meia dobra	15,000
Meia Pica	7,500

The above are struck in Portugal.

Silver.

	Reis.
Rupia	720
Meia Rupia or Pardau	360
Meio Pardau	180

Copper.

	Reis.
Tanga	60
Meia Tanga	30
Vicetem	20
Quarto de Tanga	15

There were, in addition to the above, smaller copper pieces of 12, 10, 9, 7½, 6, 4½, 3 and 1½ reis in use. English money and the Spanish dollar are also current in the country.

In compiling these notes I have to acknowledge the very generous assistance received from Dr. J. Gerson da Cunha in the translation of various old Portuguese documents, and without whose aid much interesting matter would necessarily have been omitted.

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* The Meteorological Reporter to the Government of India gives the following as the results of the last four years' observations at Panjim: Average rainfall 107·04 inches; the average mean temperature for the year is 81·9 F.; the hottest month appears to be May, the mean of the maximum temperatures of this month being, in 1878, 91°; and in 1877, 89°·1; the coldest month appears to be January or February; the mean minimum temperature for January 1878 was 72°·4, and for February 1877, 73°·4. The highest temperature registered in 1878 was 93″, and in 1877, 91″·8. The lowest temperature registered in 1878 was 67°·8, and in 1877, 68°.

APPENDIX J.

List of Charts, &c., issued at the Marine Survey Department from April 1875, the date on which work was commenced at Head-quarters, to 30th September 1880.

INDIAN OCEAN

Office No. of Chart.

O. 11. Indian Ocean, Curves of equal magnetic variation. By R. C. Carrington, F. R. A. S. *Price, Annas* 8.

O. 1257. Arabian Sea, western portion, with plans of Babel Mandeb Strait and Zanzibar harbour. Compiled from the latest Government Surveys, by R. C. Carrrington, F.R.A.S. *Price, Rs.* 1-8. (*In progress*).

O. 1257*a*. Arabian Sea, eastern portion, with plans of Kurrachee, Bombay, Colombo, Galle, and Madras. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S. *Price, Rs.* 1-8. (*In progress*).

INDIA, WEST COAST.

N. 15. Kurrachee to Vingorla. Compiled from the latest Government Surveys, by R. C. Carrington, F. R. A. S., 1876. *Price, Rs.* 1-12.

N. 15*a*. Vingorla to Cape Comorin. Compiled from the latest Government Surveys, by R. C. Carrington, F R. A. S., 1876. *Price, Rs.* 1-12.

N. 25. Port of Salaya or Seraia. By Commander A. D. Taylor, I.N., 1879. *Price, Re.* 1.

N. 1217. Cutch Mandvi. By Commander A. D. Taylor, I.N., corrected to 1879. *Price, Re.* 1.

N. 27. Verâwal Roads. By Lieutenants Constable and Stiffe, I.N., 1853, corrected to 1878. *Price, Re.* 1.

M. 39. Sketch of the entrance to Rajpuri River. By Navigating Lieutenant W. P. Haynes, R.N., 1876. *Price, Annas* 8.

M. 1190. Ratnagiri, including Mirya and Kalbadavie Bays. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878. *Price, Re.* 1.

M. 1231. Kundari Island to Chaul. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1879. *Price, Re.* 1.

M. 1232. Chaul and Entrance to Kundalika River. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1879. *Price Re.* 1.

M. 1191. Rajapur Bay and Viziadurg with adjacent Coast. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878. *Price, Re.* 1.

M. 1233. Jaygad and Entrance to Shastri River. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1879. *Price, Re.* 1.

M. 1234. Dabhol and Entrance to Wáshishti River. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1879. *Price, Re.* 1.

M. 1252. Bankot and Entrance to Savitri River. By Navigating Lieutenant E. W. Petley, R.N., 1880. (*In progress.*)

M. 43. Goa and Marmagao Roadsteads. By Commander A. D. Taylor, I.N., 1877. *Price, Annas* 12.

K. 63. Sadashivgad Bay, including the port of Karwar and Beitkul Cove. By Navigating Lieutenant E. W. Petley, R.N., 1880. (*In progress.*)

L. 1176. Narakel Anchorage. Compiled from the latest Government Surveys, 1878. *Price, Annas* 8.

I. 851. Quilon Roads. By Lieutenant A. D. Taylor, I.N., 1858. *Price, Annas* 8.

K. 61. Lakadivh Group—Charbaniani Reef, Chitlac and Kiltan Islands. By Lieutenants Selby and Taylor, I.N., 1848. *Price, Annas* 12.

L. 53. Byramgore Reef or Chereapani, and Angria Bank. By Lieutenants Selby and Taylor, I.N., 1848. *Price, Annas* 8.

J. 81. Kolachel Roadstead, with plan of Enciam Rocks. Surveyed by M. Chapman, I.N., 1875. *Price, Rs.* 1-8.

EAST COAST OF INDIA, BAY OF BENGAL, CEYLON, &c.

N. 15*b*. Cape Comorin to Cocanada, including the Island of Ceylon. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876. *Price, Rs.* 1-12.

M. 1218. Tuticorin Roadstead and Harbour. Surveyed by M. Chapman, I.N., 1879. *Price, Re.* 1.

G. 93. Approaches to Jafnapatam. Compiled from the latest Government Surveys, 1878. *Price, Re.* 1.

G. 95. Paumben Pass. Surveyed by M. Chapman, I.N., 1878. *Price Re.* 1.

G. 1184. Approaches to Paumben Pass. Surveyed by M. Chapman, I.N., 1878. *Price, Re.* 1.

Office No. of Chart.	
G. 1235.	Mullaittivu or Moeletivoe. By J. Donnan, 1879. *Price, Annas* 8.
G. 1175.	Colombo Harbour and its approaches. Compiled from the latest Government Surveys, 1878. *Price, Re.* 1.
G. 1171.	Approaches to Point de Galle Harbour, Ceylon. By T. H. Twynam and Commander A. D. Taylor, 1877. *Price, Re.* 1.
F. 103*a*.	Bay of Bengal, Western Sheet. Complied from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1878. *Price, Rs.* 2.
F. 103*b*.	Bay of Bengal, Eastern Sheet. Complied from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1879. *Price, Rs.* 2.
F. 104.	Coromandel Coast. Sheet No. 2, from Latitude 15° to 16° 30′ N. *Price, Re.* 1.
F. 104.	Sheet No. 3, from Latitude 13° to 15° N. *Price, Re.* 1.
F. 104.	Sheet No. 4. Lieutenant M. A. Sweny, I.N., 1859-60. *Price, Re.* 1.
F. 105.	Madras Roadstead. Surveyed by Navigating Lieutenant F.W. Jarrad, R.N., F.R.A.S., 1876. *Price, Re.* 1.
F. 1172.	Orissa Coast, Narsapur Point to Palmyras Point, adapted to the latest determinations of the G. T. S., and observations by Commander A. D. Taylor, I.N. Compiled by R. C. Carrington, F.R.A.S., corrected to 1878. *Price, Re.* 1.
N. 15*c*.	Cocanada to Bassein River. Compiled from the latest Government Surveys, by R.C. Carrington, F.R.A.S., 1876. *Price, Rs.* 1-12.
F. 113.	Coringa or Cocanada Bay showing the Northern Godavery Mouths. By Navigating Lieutenant G. C. Hammond, R.N., 1875. *Price, Rs.* 1-8.
F. 1165.	False Point Harbour and approaches. By Navigating Lieutenant G. C. Hammond, R.N., 1876, corrected to 1880 by Commander A. D. Taylor, I.N. *Price, Re.* 1.
E. 117.	Hooghly River.—Luff Point to Anchoring Creek, showing the James and Mary Shoals and entrance to the Roopnarain River. By Navigating Lieutenant Coghlan, R.N., 1875. *Price, Rs.* 1-8.
E. 115.	False Point to Mutlah River, showing the approaches to Sandheads. From the latest Government Surveys. Compiled by R. C. Carrington, F.R.A.S., corrected to 1878. *Price, Re.* 1.
E. 115*a*.	Mutlah River to the Chittagong Coast. Compiled from the latest Government Surveys, 1879. *Price, Re.* 1.
D. 126.	Chittagong or Kornafuli River. Surveyed by Lieutenant G. C. Hammond, R.N., 1876. *Price, Re.* 1.

COAST OF BURMA, &c.

N. 15*d*.	Bassein River to Pulo Penang, including the Andaman and Nicobar Islands. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., 1876. *Price, Rs.* 1-12.
C. 134.	Coronge Island to White Point, including the Gulf of Martaban. Compiled from the latest Government Surveys, by R. C. Carrington, F.R.A.S., corrected to 1878. *Price, Re.* 1.
C. 137.	Preparis North Channel and Entrance to Bassein River. By Commander A. D. Taylor, I.N., and latest Government Charts. Compiled by R. C. Carrington, F.R.A.S., 1879. *Price, Re.* 1.
C. 143.	Rangoon River Approaches. Surveyed by Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1876. *Price, Re.* 1.
C. 145.	Entrance to Salween (Maulmain) River. Surveyed by Navigating Lieutenant F. W. Jarrad, R. N., F.R.A.S., 1877. *Price, Re.* 1.
B. 151.	Coast of Tenasserim—Tavoy River, from a sketch by Lieutenant R. Moresby, with Corrections and Additions, by Commander A. D. Taylor, I.N., 1876. *Price, Re.* 1.
A. 171.	Port Mouat, Andamans. Surveyed by F. W. Allen, Commanding I. G. S., *Constance*, 1880.

SIAM, MALAY PENINSULA, WEST COAST.

B. 1173.	Hayes Island to the Pilgrims. Surveyed by Commander A. deRichelieu Siamese Navy, 1877. *Price, Re.* 1.
B. 159.	Kopah Inlet, from a Sketch by Commander A. D. Taylor, I.N., 1876. *Price, Re.* 1.
B. 1164.	Salang Island (Junkseylon). Commander A. deRichelieu, Siamese Navy, 1876. *Price, Re.* 1.
B. 1163.	Junkseylon, East Coast—Puket or Tonkah Harbour. By Commander A. deRichelieu, Siamese Navy, 1876. *Price, Re.* 1.

GULF OF SIAM.

ZZe 1177.	Siam Gulf, West Coast, Hilly Cape to Lacon Bight. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872. *Price, Re.* 1.

Office
No. of Chart.

ZZ*e* 1179. Siam Gulf, West Coast, Lacon Bight to Lem Chang P'ra. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872. *Price, Re.* 1.

ZZ*e* 1174. Patani Bay. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872. *Price, Annas.* 8.

ZZ*e* 1178. Singora Roadstead and Inner Harbour. Surveyed by Captain A. J. Loftus, Siamese Navy, 1872. *Price, Re.* 1.

ZZ*e* 1180. Lacon Roads. Surveyed by Captain A. J. Loftus, Siamese Navy, 1871-72. *Price, Re.* 1.

ZZ*e* 1181. Samuie Strait. Surveyed by Captain A. J. Loftus, Siamese Navy, 1871-72. *Price, Re.* 1.

ZZ*e* 1182. Langsuen Roads. Surveyed by Captain A. J. Loftus, Siamese Navy, 1871-72. *Price, Re.* 1.

SAILING DIRECTIONS, &c.

The Sailing Directory, Part I, India, Africa and South America with Charts by Commander A. D. Taylor, I.N., F.R.G.S., Super Royal 8vo., cloth, lettered. *Psice, Rs.* 16; *packing and postage Rs.* 1-12.

Return of Wrecks and Casualties in Indian Waters for the year 1877, together with a Chart showing the positions in which they occurred. Prepared by R. C. Carrington, F.R.A.S., F.R.S.L., Registrar of Wrecks. *Price Rs.* 2.

Ditto ditto for 1878. *Price Rs.* 2.

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List of Light-houses and Light-vessels in British India (Suez to Singapore), corrected from official information. By R. C. Carrington, F.R.A.S., 1880. *Price Re.* 1.

Spheroidal Table, for every ten minutes of the quadrant, showing the length in feet of a degree, minute, and second of latitude and longitude; the corresponding number of statute miles in each degree of latitude; the number of minutes of latitude, or nautic miles contained in a degree of longitude, under each parallel of latitude, and the length, in cables, of a minute of longitude, corresponding to each nautic mile. Compression $\frac{1}{294}$. By R. C. Carrington, F.R.A.S., 1877. *Price, Re.* 1.

Glossary of French Terms adopted on French Charts and maps and in sailing directions. By R. C. Carrington, F.R.A.S., Marine Survey of India, 1879. *Price,* 12 *annas.*

Catalogue of Charts, Maps, Plans, &c., in the Marine Survey Department, Calcutta Compiled by R. C. Carrington, Marine Survey of India, 1879. *Price,* 8 *annas.*

HYDROGRAPIC NOTICES.

Price four annas each.
No.

1. Rangoon River. By Navigating Lieutenant F. W. Jarrad, R.N., 1876.
2. Cancelled; superseded by Notice No. 8.
3. Cancelled; superseded by Notice No. 18.
4. Cancelled; superseded by Notice No. 23.
5. Kyouk Phyou Harbour. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1877.
6. Salween (Maulmain) River. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1877.
7. Approaches to Point de Galle Harbour. By Commander A. D. Taylor, I.N., 1877.
8. Mergui Archipelago. Pages 7 to 10 of this Notice superseded by Notice No. 18.
9. Indus Banks and Kurrachee. By Lieutenant A. W. Stiffe, I.N., and the Master Attendant of Kurrachee, 1877.
10. Pamban (Paumben) Pass. By Morris Chapman, I.N., 1878.
11. Andaman Islands. By Navigating Lieutenant J. Tully, R.N., 1878.
12. Jiddah Harbour, Red Sea. By Commander W. J. L. Wharton, R.N., H. M.'s Ship *Fawn*, 1878.
13. Red Sea. Navigation, Inshore passages, 1878.
14. Red Sea. 1878.
15. South Indian Ocean, Seychelle, Farquhar Islands, and Madagascar. By Commander W. J. L. Wharton, R.N., H. M.'s Ships *Shearwater* and *Fawn*, 1875-78.
16. Torres Strait and New Guinea, South-East Coast. By Officers of H. M.'s Ships employed on the Australian Station, 1878.
17. India, West Coast, Ratnagiri, Rajapur Bay and Viziadurg. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1878.
18. Coast of Siam, including Junkseylon and adjacent islands. By Commanders A. D. Taylor, I.N., and A. deRichelieu, Siamese Navy, 1879.
19. Africa, East Coast, Pemba Island and Adjacent coast. By Commander W. J. L. Wharton, R.N., H. M.'s Surveying Vessel *Fawn*, 1878.
20. India, West Coast, the coast from Kundari Island to Chaul, and the harbours of Dabhol and Jaygad. By Navigating Lieutenant F. W. Jarrad, R.N., F.R.A.S., 1880.

21. Arabian Coast, Rás Matbakh, 1880.
22. Red Sea. Notes from various sources, 1880.
23. Coast of Orissa. False Point Harbour and approaches. By Navigating Lieutenant G. C. Hammond, R.N., and Commander A. D. Taylor, I.N., 1880.
24. India, West Coast, Harbours of Karwar and Bankot. Compiled from notes by Navigating Lieutenant E. W. Petley, R.N., and remarks by Commander A. D. Taylor, late I.N., 1880.

NOTICES TO MARINERS.

Notices to Mariners issued during the year 1875. *Price, one anna each* :—

No. 1. Fixed Light on Green Island, Hong Kong, China.
„ 2. Malwan Rock, Malwan.
„ 3. Fixed white Light at Dwarka, Kattywar.
„ 4. Mooram Shulli Tivo Island, and Devil's Point Gulf of Manaar.
„ 5. (1) Fixed light at Vizagapatam.
(2) Coral shoal off Caltura, Ceylon.
(3) Rock off Barberyn Island.
„ 6. Foundering of the Buoy Vessel *Mata Mata*, Rangoon.
„ 7. (1) Revolving Light near Acheen Head, Malacca Strait.
(2) Auxiliary Light to above.

Notices to Mariners issued during the year 1876. *Price, one anna each* :—

No. 1. Temporary discontinuance of Hope Island Light during repairs to Light-house column, Coromandel Coast.
„ 2. Exhibition of Hope Island Light, Coromandel Coast.
„ 3. Prohibited anchorage near the British Indian Sub-marine Telegraph Cable, Madras.
„ 4. (1) Pulo Brasse auxiliary Light, Malacca Strait.
(2) Island between Pulo Nias and Sumatra.
„ 5. Vessels trading to Réunion, Indian Ocean.
„ 6. Replacement of the Buoy on the western edge of Dolphin Shoal, Chittagong Coast.
„ 7. China Bakeer Light, Martaban Gulf.
(2) Intended exhibition of Light on the Oyster Reef.
„ 8. Fixed white light at Veráwal.
„ 9. Buoyage of Kyouk Phyou, British Burma.
„ 10. Fixed white Light at Bet or Beyt (Gulf of Cutch), Kattywar.
„ 11. Fixed white Light at Porbandar, Kattywar.
„ 12. (1) Displacement of the Buoy in Narakel Roadstead, Cochin.
(2) Buoy marking the smooth-water anchorage to the southward of Alipee (Aulapolay), Travancore.
„ 13. (1) Intended Light on Pulo Pisang, Malacca Strait.
(2) Sunken reef in Siberoet Strait, Sumatra, West Coast.
„ 14. Deposit of stone mound at the end of the breakwater, Colombo, Ceylon.
„ 15. Period of exhibition of the *blue* Light during the South-West monsoon, from the Eastern Channel Light-vessel at the entrance to River Hooghly.
„ 16. Rock near west end of Pulo Brasse.
„ 17. (1) Beacon on two-fathom patch off Batticaloa Road, Ceylon.
(2) Suspension of Light at Vizagapatam.
„ 18. Directions for Kurrachee Harbour.
„ 19. Beacon on two-fathom patch off Batticaloa Road, Ceylon.
„ 20. Fixed light at Callingapatam Point, Coromandel Coast.

The following Notices to Mariners were issued during the year 1877. *Price, one anna each* :—

No. 1. Alteration in Manora Point Light, Kurrachee.
„ 2. Dangers at Goa and Marmagao Roadstead.
„ 3. Existence of rocky patches, Beypore.
„ 4. Pooree Port limits, Orissa Coast.
„ 5. Extension of the Hajamri Mouth of the River Indus.
„ 6. Red Lights at Port Victoria, Mahé, Seychelles.
„ 7. Light at Port Berberah, Gulf of Aden.
„ 8. Rock off Hingie Island, Bassein River.
„ 9. Rock off Pegu Coast.
„ 10. Coral Patch near Sultan Shoal, Singapore Strait.
„ 11. "Intermediate" Light-ship, entrance to River Hooghly.
„ 12. Position of Cochin Light-house.
„ 13. Position of Raleigh Rock, and additional beacons, Bombay.
„ 14. Buoy, marking Gindurah Rock, Galle.
„ 15. Alteration in Manora Point Light, Kurrachee; and discovery of a bank near Towak Island, Red Sea.
„ 16. Dangerous rocks in Forest Strait, Mergui Archipelago, and Richelieu Rock off Kopah Inlet.
„ 17. Alteration in position of "Intermediate" Light-ship, entrance to River Hooghly.
„ 18. Destruction of the Krishna Shoal Light-house.
„ 19. Correct position of Santipilly Light-house.
„ 20. Anchorage Buoys in Madras Roadstead.
„ 21. Light-vessel near Krishna Shoal, Burma.
„ 22. Additional information, Krishna Shoal Light-vessel and Light at Pooree.
„ 23. Alteration of position of Chittagong Lights.
„ 24. Night Signals shown by British Pilot Vessels in the English Channel.

Notices to Mariners issued during the year 1878. *Price, one anna each* :—

No. 1. Position of Middle Ground, Bombay.
„ 2. Error in position of Krishna Shoal Light-vessel.
„ 3. New Lights in Sunda Strait, &c.
„ 4. Corrected position of Krishna Shoal Light-vessel.
„ 5. Alteration of colour of Chittagong beacons, and intended alteration in Dolphin Rock Light, Bombay.

No. 6. Alteration of Malwan Light.
„ 7. Kintoan Light-vessel, Yang-tse-Kiang.
„ 8. Burgess Rock off Hingie Island, Bassein River, Burma.
„ 9. Fairway Buoy at False Point, Orissa.
„ 10. (1) Intended Light and Fog Signal on Little Basses Rocks, Ceylon.
(2) Intended alteration in Great Basses Rocks Fog Signal.
„ 11. Corrected positions of Zebayir Islands, Jebel Zukur, and the Hánish Islands, Red Sea.
„ 12. Fog Signals and distinguishing marks for Light-vessels, River Hooghly.
„ 13. Exhibition of Light on Little Basses Rocks, Ceylon.
„ 14. Beacon on Chaul Kadu Rock, Bombay.
„ 15. Shoal near Tumb Island (Jazirat Tanb), Persian Gulf.
„ 16. Light at Batticaloa, Ceylon.
„ 17. Upper Gasper Light-vessel, entrance to River Hooghly.
„ 18. Red Lights on North Groyne of Harbour Works, Madras.
„ 19. Reported Shoal, N. N. E. of Bahrein, Persian Gulf.
„ 20. Alteration of colour of light at Klang Strait, Strait of Malacca—Salangore—Malay Coast.
„ 21. Additional information concerning the reported Shoal, N. N. E. of Bahrein.
„ 22. Deposit of Stone, eastward of Harbour Works, Madras.
„ 23. Reported Shoal, North-West of Cheduba Island.
„ 24. Exhibition of blue lights and Maroons at Krishna Shoal Light-vessel.
„ 25. Deposit of Stone, eastward of Harbour Works, Madras (additional information).
„ 26. Vessels prohibited from anchoring near the Sub-marine Telegraph Cable between Diamond Island and the mainland.
„ 27. Intended exhibition of a revolving Light at Vakalapudi, in the Godavery District.

Notices to Mariners issued during the year 1879. *Price, one anna each* :—

No. 1. Permanent moorings for Eastern Channel Light-vessel, entrance to Hooghly River.
„ 2. Sunken danger in Mergui Archipelago.
„ 3. Revolving light at Vakalapudi, in the Godavery District.
„ 4. Intended alteration in False Point Light.
„ 5. Shifting of the entrances to Honore (Honawar) and Mangalore, on the Malabar Coast.
„ 6. Fixed Light at Roji (Nowa Nugga) in the Gulf of Cutch.
„ 7. Fixed Light at the entrance to Toona Creek in the Gulf of Cutch.
„ 8. Fixed Light at Goapnath Point in the Gulf of Cambay.
„ 9. Wreck marking vessels.
„ 10. The alteration in the position and improvement of Pooree Port Light.
„ 11. Shoal Coral Ground in Strait of Banka.
„ 12. Delagoa Bay. Removal of Cockburn Light-vessel in bad weather.
„ 13. (1) Alteration in position of Beacons and Leading Lights—Burnett River Entrance, Australia.
(2) Fixed Light on Flat-top Islet—Pioneer River—Rocky Islets.
(3) Revolving Light on Low Isles—Trinity Bay.
(4) Leading Lights at Cook Town—Endeavour River Entrance—Cook Harbour.
„ 14. Sunken dangers between Alguada Reefs and Diamond Island—Bay of Bengal.
„ 15. Flashing white Light on Puysegur Point—New Zealand.
„ 16. Dangerous Rocks, N. N. W. and S. E. of the southernmost of the Brothers Islands—Andaman Islands.
„ 17. Australia—South Coast—Gulf of St. Vincent.
(1) Prohibited Anchorage near Telegraph Cable, Port Phillip.
(2) Buoys marking Battery Practice Range at Williams Town.
(3) Fixed and Flashing Light on North Reef.
„ 18. Longitude of the Time Ball, Calcutta, and of Saugor Light-house, River Hooghly.
„ 19. (1) Discontinuance of additional Light at Fourth Point—Sunda Strait—Java.
(2) Shoal in the Fairway to Batavia Road,
(3) Fixed Light on Meinder's Reef—Madura Strait.
„ 20. (1) Shoal ground westward of Durnford Point—South Coast of Africa.
(2) Distinguishing features marking the entrance to Tugela River.
(3) Ditto entrance to Umhloti River.
„ 21. Buoys off Carwar Harbour (Sedashigar).
„ 22. (1) Alterations in Lights at St. Paul and St. Denis, Réunion Island.
(2) Harbour Light at St. Pierre.
„ 23. Buoys off Carwar Harbour (Sedashigar).
„ 24. Buoys and Beacons, Zanzibar Harbour.
„ 25. Alteration of False Point Light—Coast of Orissa.
„ 26. Red Buoy marking smooth-water anchorage off Porcaud, Alleppey.
„ 27. Change in the Anchorage Limits of the Port of Madras.
„ 28. Intended discontinuance of light at El-weg (Sherm Wej-h), Red Sea.
„ 29. Interval of intended exhibition of blue Lights and rockets at False Point Light-house.
„ 30. Replacing of the buoys at the entrance to Cochin Harbour, and extinguishing of Narrakel Light.
„ 31. Range of visibility of the Light exhibited from Krishna Shoal Light-vessel.
„ 32. Light at Batticaloa.
„ 33. Black buoys laid down in Calicut Roadstead to mark the limits of foul ground.
„ 34. Light at Batticaloa.
„ 35. Replacing of the buoys off Carwar Harbour (Sedashigar).
„ 36. Telegraph buoy, south of Aden.
„ 37. Black buoy off Point Gordeware (Godavery).
„ 38. Light at Batticaloa.
„ 39. Exhibition of a leading Light in Suez Bay.
„ 40. Madras Semaphore,
„ 41. Black buoy off Point Gordeware (Godavery.)
„ 42. Madras Semaphore.
„ 43. Buoys at Calicut.

Notices to Mariners issued during the year 1880. *Price, one anna each*:—

No. 1. Prohibited anchorage near the telegraph cables in Zanzibar Harbour.
„ 2. Discontinuance of maroon Lights at Krishna Shoal Light-vessel.
„ 3. Exhibition of the new fixed Light at False Point.
„ 4. Extension of the period of exhibition of the "Intermediate" Light at the entrance to the Hoogly River,

No. 5. Alterations in the position and visibility of the Light exhibited from Fort Canning, Singapore.
„ 6. Alteration of position and elevation of the red Light at Cannanore.
„ 7. Discontinuance of the exhibition of maroons from the Light-vessels of the Hooghly River.
„ 8. Fixed light at Tolkeshwar, Dabhol or Anjanvel.
„ 9. Lights at Port Ibrahim, Suez.
„ 10. Changes in the buoyage of the port, Madras.
„ 11. Intended alteration of Kenery (Kundari) island light.
„ 12. Flashing light on Flat Cape, Sunda Strait.
„ 13. Destruction of First Point light-house, Java.
„ 14. Harbour light at Beliling, Baly Island.
„ 15. Position of Gwalia reef, Carimata Strait.
„ 16. Position of Parkin rock, Hánish Islands, Red Sea.
„ 17. Shoal south-west of Barren Islands, west coast of Madagascar.
„ 18. Intended alteration in light apparatus at Calicut.
„ 19. Lights at Port Ibrahim, Suez (additional information.)
„ 20. Intermittent flashing light on Pulo Undan, Malacca Strait.

⁂ *The above rates are exclusive of mounting, colouring, packing, and postage.*

K.

Statement shewing the cost of the Marine Survey Department from the 1st October 1879 to the 30th September 1880.

Particulars.	Amount of each item.			Total of each heading.		
Office of the Superintendent of Marine Surveys.	Rs.	As.	P.	Rs.	As.	P.
Superintendent of Marine Surveys	21,600	0	0			
Superintendent, Compiling and Drawing Branch ...	12,600	0	0			
House-rent allowance of ditto	1,098	0	0			
Office Establishment	9,788	7	9			
Office Contingencies	4,006	0	0			
Travelling and Halting allowances of the Superintendent of Marine Surveys during inspection journeys	2,264	14	0			
				51,357	5	9
Scientific Officers.						
Scientific Officers	29,906	1	8			
Medical Officer and Naturalist	4,740	0	0			
Field allowance of Surveyors whilst absent from Calcutta on surveying duties	11,205	0	0			
Travelling allowance of ditto	224	10	0			
				46,075	11	8
No. 1 Survey Party.						
Wages of crew	8,148	15	3			
European and Native provisioners	1,517	1	1			
Contingencies	2,163	7	7			
Repairs of steam cutters	1,568	0	0			
Passages of crew	97	3	0			
				13,494	10	11
No. 2 Survey Party.						
Wages of crew	296	12	3			
European and Native provisioners	29	1	7			
Contingencies	88	3	0			
Passages of crew	86	0	0			
				500	0	10
Miscellaneous Charges.						
Instruments for Tidal Observatory at Port Blair ...	2,278	12	9	2,278	12	9
TOTAL ...	......			1,13,706	9	11

A. D. TAYLOR,
Superintendent, Marine Survey of India.

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